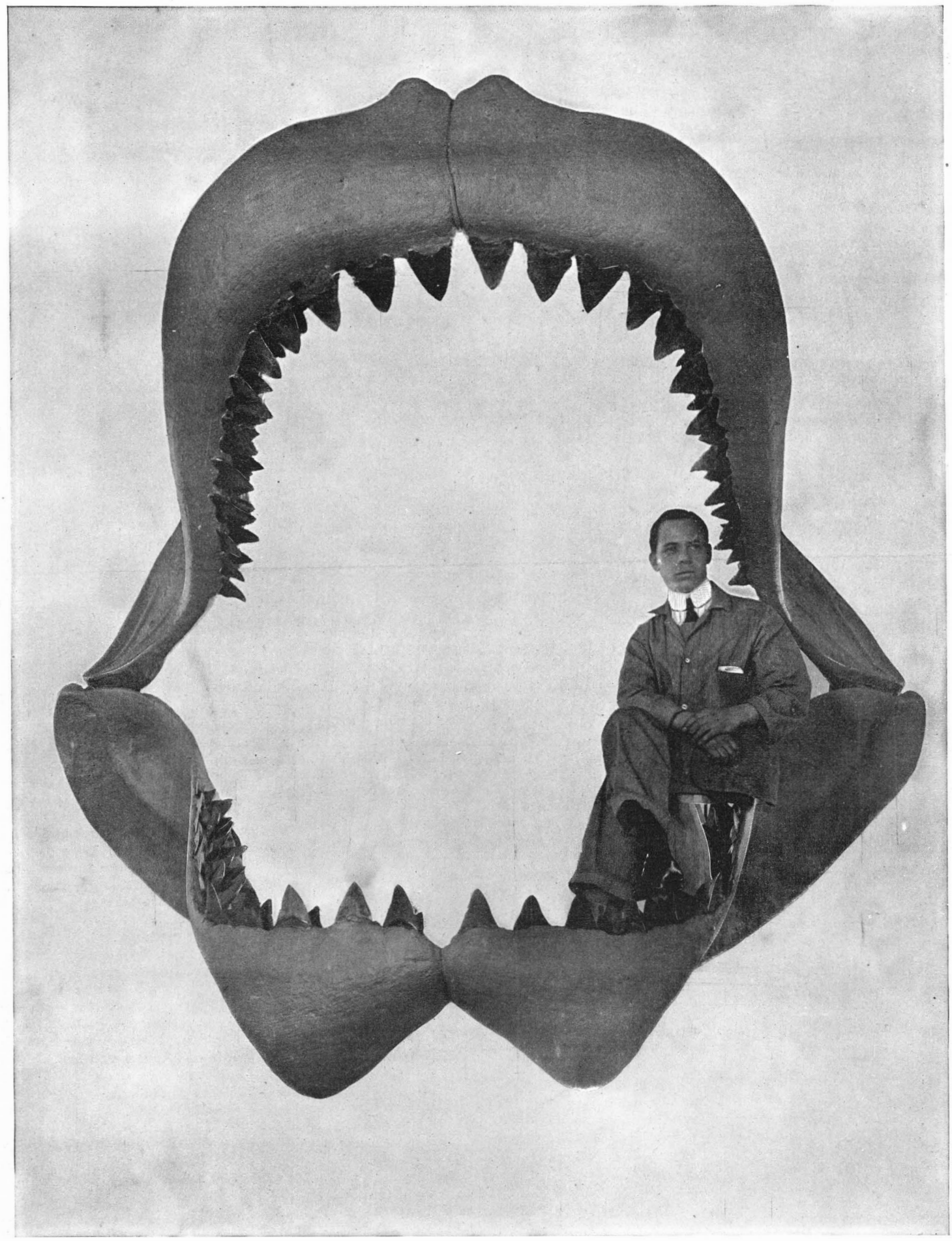
SCIENTIFIC AMERICAN



RESTORED JAWS OF GIANT FOSSIL SHARK.—[See page 103]

July 29, 1916

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, July 29, 1916

Charles Allen Munn, President, Frederick C. Beach, Secretary.
Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada
Trade Mark Registered in the United States Patent Office

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Our Superb Battle Cruisers

IT is in strict agreement with well proved theory, with American naval tradition, and with the lessons of the great European War, that the Navy Department has decided upon the extraordinary dimensions, speed and power of our battle-cruisers—the first of this type to be built for the American Navy.

In every respect, except possibly that of armor protection, these ships will greatly surpass any existing ships of their type in the navies of the world; and although the designs are not yet complete, they are so far advanced as to make it possible to describe them with some degree of certainty.

Perhaps the most spectacular feature in the new ships is their speed, which is to be 35 knots. This is fully five knots greater than that of any existing battle-cruiser—in fact, it is equal to the speed of the fastest destroyers and is several knots greater than the speed of 80 per cent of the destroyers afloat in the navies of the world to-day.

To secure this speed great refinement of hull and enormous horse-power are necessary. As regards the former, the new battle-cruisers will be as fine, under water, if not finer than our destroyers. Their over-all length will be between 800 and 900 feet (the longest existing warship is the "Lion," 675 feet on the water-line), their beam will be 97 feet and their full-load displacement will be close to 40,000 tons.

The towing tank tests at Washington have shown that to secure 35 knots it will be necessary to put into these ships an engine and boiler plant of 175,000 horse-power. This is an enormous figure; but the estimate is justified by a comparison with the "Lusitania." The Lusitania was 790 feet long by 88 feet beam. When working up to her maximum horse-power of 70,000, she could make something over 25 knots. A simple calculation shows that to drive her at 35 knots would require about 195,000 horse-power.

It will be asked: how will it be possible to secure this speed (35 knots) in the much larger battle-cruisers? The answer is to be found partly in their finer form, but more particularly in the great advance in boiler, engine-room and propeller efficiency, which has taken place since the "Lusitania" was built. In her day the problem of reconciling the demand of the propellers for slow speed of rotation and of the turbines for high speed had not been solved. Propeller and turbine, being on the same shaft, were condemned, the one (propeller) to run above its best economical speed and the other (turbine) below it. The consequence was that the total efficiency of the "Lusitania" was something less than 50 per cent.

Of late years the problem has been briliantly solved by the introduction of reduction gearing and the electric drive between turbine and propeller. Westinghouse and Parsons have achieved good results with mechanical gearing; but the best economy has been obtained with the turbo-electric drive, as developed by the General Electric Company and applied with great success to one of our naval colliers. In this system the requisite power is developed by turbo-electric generators, and transmitted to motors on the propeller shafts. The great economy of this method as compared with the direct-connected turbine drive of the "Lusitania," is due largely to the fact that both the turbines and the motors can be run at their most economical speed—a high speed for the turbines and a low speed for the motors and their direct-connected propellers.

The high economy of this system brings with it a reduction in weights and space occupied. Thus the production of the 175,000 horse-power required for the new battle-cruisers will be entrusted to four 35,000-kw. turbo-generators. These units are 50 ft. 7 in. long, 22 ft. wide and 15 ft. high. Hence, by placing them on two decks they would occupy a space only, say, 55 ft. wide by 35 ft. high by 55 ft. long—a remarkably small space to contain an engine plant of 175,000 horse-power.

If the ships are 850 ft. long by 97 ft. broad, there will be ample space for the fuel and boiler plant—the engine-room occupying so little of the ship's length. It is true the engine and boiler plant of the "Lusitania" occupied three-fourths of the ship's length; but in our new cruisers, oil fuel, stored in the double bottom, will take the place of the "Lusitania's" 7,000 tons of coal, and compact water-tube boilers will be used in place of the bulky Scotch boilers of the Cunard liner.

Thirty-five knots is forty miles an hour. The 175,000 horse-power of the new ships will be 25,000 horse-power more than the total horse-power of the Fifty-ninth Street power station, which operates the whole New York subway system. To obtain a spectacular view of what these huge battle-cruisers mean, consider that they are capable of rushing across the high seas the whole equipment of one of the world's largest power stations at a speed of forty miles an hour!

The armament will consist of eight 16-inch, 45-caliber guns of a new type recently developed by our navy. This is the most powerful gun in existence. It fires a shell weighing 2,400 pounds with an initial velocity of 2,600 feet per second and an initial energy of 100,000 foot-tons. So, when a salvo bursts forth, it will represent 800,000 foot-tons—sufficient energy to lift 1,000 tons 800 feet into the air. The guns will have 20 or 25 degrees of maximum elevation and a possible fighting range of 25,000 to 30,000 yards.

A naval officer who was intimately connected with the development of this gun assures us that in clear weather, favorable to "spotting," it would be possible to get onto an enemy ship at 25,000 yards, and plant successive salvos upon her with accuracy.

Because of their speed, a squadron of these cruisers could choose the range, fighting at a distance at which the energy of the enemy's lighter shells would be greatly spent, but at which the enormous 2,400-pound projectiles would posses full penetrative and smashing power.

Why Health Authorities Are Baffled

MOST of our readers have undoubtedly kept well in touch with the important points brought out by the present outbreak of poliomyelitis, or infant paralysis, as it is popularly called, in this city. Certainly the Department of Health, in most commendable fashion, has utilized the newspapers and other agencies to spread before the people of the city all the known facts concerning this infection, and has roused the people to a realization of the importance of general cleanliness in the prevention of disease. How well these efforts have succeeded can easily be seen by a walk through what has always been one of the filth spots of the city, the lower East Side. "If the present spasm of cleanliness could only be made to continue," said a prominent settlement worker a few days ago. "But the epidemic will soon be forgotten, and with it we shall probably return to the former dirty conditions. It is a characteristic of this country."

This is probably too pessimistic a view. We cannot but feel that the Department of Health has rendered the city a notable service by courageously making public, as it has, all the facts relating to the present outbreak. The educational impulses thus set in motion are bound to have a lasting effect in promoting the health of the community.

It is interesting to observe how quickly the science of medicine progresses. Less than ten years ago, when the 1907 epidemic was studied, it was not even definitely established that the disease was infectious; it certainly had not been transmitted to animals. In contrast to this, our present knowledge of the disease is really considerable. The disease is caused by a living virus—that it, by a germ. This germ is so extremely minute as to be invisible even with a bacteriological microscope magnifying 1,000 diameters. The virus is present in the brain and spinal cord of the infected individuals, also in the mucous membranes of the nose and throat of such individuals and in their intestinal discharges. More than this, the virus is often present in the nose and throat of healthy persons who have been in contact with an infected individual. While it is extremely unlikely that the germ of poliomyelitis lives and multiplies elsewhere than in the situations just mentioned, or at least elsewhere than in the human (animal?) body, experiments have demonstrated that the germ may be present in the dust of a room harboring a patient ill with the disease.

Several inquirers have asked how we can possibly know anything about the size of a micro-organism which we have never seen. This is not at all difficult. In fact, we know something about the size of a number of other germs which have not yet been seen; for example, measles, hog cholera, yellow fever. The germs of these diseases belong to what are called "filterable viruses," a term used to denote that the virus passes through unglazed porcelain filters. Such filters have extremely fine pores; so fine, in fact, that they readily hold back all the ordinary bacteria. The filterable viruses, however, consist of germs so extremely minute that they readily pass through the pores of the porcelain. Looked at under the microscope, even with the magnification of 1,000 diameters, no sign of a germ can be discovered. Even under the ultra-microscope one sees merely some fine points of light, which may possibly be the germ in question. Such filtrates, however, may be exceedingly virulent when tested by means of animal inoculations, showing that the germs are present.

A number of writers have expressed the opinion that progress looking toward the administrative control of poliomyelitis depends almost wholly on the discovery of some ready method of identifying the "carriers" of the virus. And at first sight this would appear to be the crux of the problem, for the disease is undoubtedly spread to a large extent by healthy carriers and by mild, atypical (non-paralyzed) cases of the disease. We cannot but feel that this belief is unwarranted. Certainly, in the case of a number of other infections, notably typhoid fever, diphtheria, cerebro-spinal meningitis, and in pneumococcus infections, the recognition of carriers is not a difficult matter, yet in these infections such recognition has served only to add to the difficulties of the problem.

As one looks over the records and notes how a small number of cases of poliomyelitis occur in this city year after year without giving rise to an epidemic, it is clear that the determination of the correct explanation why an epidemic outbreak occurs holds also the solution of the problem of control. In this connection it is suggestive that practically all of the children affected during the present epidemic were born since the extensive epidemic in New York city in 1907. Does this perhaps indicate that a considerable population of non-immune children had grown up because there was relatively little poliomyelitis infection about to immunize them?

Considerations such as these, to be sure, are mere speculations. Nevertheless, we ought here to do some very logical reasoning. If measures which succeed in diminishing the amount of infection in a community also decrease the amount of immunization against that infection, and so lead to the accumulation of a large group of susceptible individuals within that community, is it sound practice to proceed on the present preventive lines? Should we, instead, seek for some safe and effective means of making the community immune against infection? In this connection we have but to remember that measles, at the present time, runs a comparatively mild course in most civilized countries. Nevertheless, some years ago, when the disease was accidentally introduced into one of the Pacific islands, where the infection was previously unknown, the mortality was extremely high and claimed thousands of victims, both old and young. In other words, eradication or immunization, which method shall we adopt?

Radioactive Evidence of the Age of the Earth

ESTIMATES of the age of the earth based on radioactive and ordinary geological phenomena differ greatly from each other. In a recent discussion of this subject Mr. Arthur Holmes points out that estimates of the former category have all been based on the assumption that the radioactive "constants" of uranium and its daughter elements have not varied with time. On this assumption it is calculated that something like 1,500,000,000 years represent the time that has elapsed since the crystallization of the oldest plutonic rocks of the earth's crust. Since there is geological evidence that these rocks are intrusive into a pre-existing sedimentary or volcanic series, the actual age of the earth would be much greater than this. On the other hand, geological estimates, founded on sedimentation and salt accumulation, point to decidedly lower figures; say 100,000,000 to 400,000,000 years. Professor Joly has suggested that the discrepancy between the radioactive and geological estimates would disappear in favor of the former if it could be shown that the rate of decay of uranium had decreased with the lapse of time. Readers of the novels of H. G. Wells, who is rapidly attaining the reputation of a Mother Shipton on the strength of the things in his stories which have later come to pass, will recall that in describing the death-dealing "atomic bomb" he introduced a concept similar to this—that of a disintegrating element which in any period of a certain fixed length dissipate exactly half its initial substance for that period. More rapid decay would, however, have been attended by a more rapid generation of heat of radioactive origin, and this would have prolonged or even reversed the secular cooling of the crust, again indicating an excessively great age for the earth. The escape from the dilemma would appear to be to deny that the earth's surface was formerly in a molten condition. The whole subject is, of course, largely speculative in the present state of science. It will, however, help greatly to elucidate the problem of the earth's age if it can be determined whether the rate of decay of uranium is dependent upon time, pressure and temperature.

Naval and Military Notes

A Machine for Digging Trenches.—The Germans have made use of a Belgian machine for digging canals as a trench digger. In one minute it excavates a cubic meter of ditch. In favorable ground it can advance over 100 yards in an hour, which is equal to the work of 200 men with pick and shovel. It can be employed only well to the rear of the firing line.

Naval Anti-Aircraft Gun.—The battleships "Pennsylvania" and "Nevada" have been equipped with a new 3-inch anti-aircraft gun of very high velocity, which has given great satisfaction to the officers of the Bureau of Ordnance who have been working on the problem for two or three years past. Two of these guns will be mounted on each of the capital ships of the Navy. According to a dispatch from Washington, they are to be mounted on the top of the gun turrets, a position, it is claimed, which will give them an excellent all round arc of fire.

Ships Proof Against the Torpedo.—Commander Charles N. Robinson, R. N., in a recent description of the British monitors, states that just below the surface the sides are made to bulge out some ten feet and then to curve in. A torpedo striking this bulge will explode amidst a variety of substances, and in all probability will do no damage to the hull. The system has been applied also to some of the old cruisers and to many new ships, including mine sweepers. The armament of the new monitors, by the way, consists in some of 14-inch guns, in others of 9.2- and 6-inch guns, while others carry only the 6-inch.

German Foresight in Artillery.—How clearly Germany foresaw the controlling influence of heavy artillery in future warfare is shown by a comparison of the respective number of guns of various caliber provided by France and Germany at the opening of the war. Of 3-inch field guns per thousand rifles France possessed 4.66 and Germany 4.12. Of light field howitzers France possessed none and Germany 1.37 per thousand rifles. Of heavy field howitzers per thousand rifles France possessed .206 and Germany .61; and of guns of all calibres Germany had 6.1 and France 4.87 per thousand rifles.

Artillery in the Austro-Italian Offensive.—In the great offensive by Austria against the Italians, reliance was placed upon her enormous concentration of artillery. Allowing that seven army corps were engaged in the attack, the normal equipment of artillery would have been 1,300 field pieces, 216 4-inch field howitzers, and 56 6-inch howitzers. Hillaire Belloc in an interesting analysis of this question states that the Austrians tripled the number of 4-inch and 6-inch howitzers; that they had four 15-inch and four 16½-inch howitzers; and that the total number of guns was 2,422. He makes the point that because of the limited railway accommodation, it will take the Austrians in their retreat several weeks to remove to another front this mass of heavy artillery and its enormous stores of ammunition.

Modern Wars are Less Deadly.—According to Lieut. C. A. L. Totten. U. S. A., modern wars are far less deadly than those of earlier date. Thus in seven battles, 1631 to 1634, the period between the introduction of firearms and the use of the bayonet, the percentages of losses in battle was 25.5. In the period 1745 to 1813, which included the "Brown Bess" and the bayonet, the percentage was 20.7. In the third period of eleven battles, from Alma to Chickamauga, 1854 to 1863, the percentage of loss was 15.5. In the period 1866 to 1870, that of the breech-loading gun, including six battles, Koniggratz to Sedan, the losses were 11 per cent. In the fifth period San Juan to Mukden, including seven battles, 1898 to 1905, the percentage fell to 10 per cent.

Great Defensive Strength of Battleships.—A careful reading of the many accounts, official and private, which have been published, describing the battle of Jutland, leaves a strong impression of the wonderful defensive qualities of the modern battleship. Because of the misty weather, battleships came under fire at ranges as short as 8,000 and even 5,000 yards, when salvo after salvo was landed upon the opposing ships. There is a saying among our naval men (or rather there was before this great fight) that the first salvo to land upon the enemy would practically decide the fight—so demoralizing would be the burst of a few high explosive shells within the ship. Nevertheless, Admiral Jellicoe speaks of one of his ships as landing seven successive salvos upon a battleship of the enemy, which apparently survived the ordeal, since the report speaks of her as having "turned away," probably to get out of range; and there is the case of the "Warspite," which, with broken steering gear, became the target for six battleships of the enemy and nevertheless effected repairs and rejoined the British fleet. Then again, the "Marlborough," although struck by a torpedo, continued in the fight and landed her salvos with effect.

Science

Native Plants as Indicators of the Agricultural Value of Land.—Messrs. Kearney and Shantz, of the U. S. Bureau of Plant Industry, have made extensive surveys of the native vegetation in typical areas of the semi-arid regions of the United States, in connection with studies of the salinity, moisture content and other physical features of the soil. The object of these researches is to work out rules for determining, from an inspection of the native plants, the agricultural possibilities of any semi-arid region; *e.g.*, whether the land is or is not suitable for dry farming and whether or not alkali is present in sufficient quantity to injure crop plants. Areas actually under cultivation furnish a check upon the results obtained.

Nitrogen Acids in Rainfall.—The composition of rainfall is of great interest from an agricultural standpoint, and has been the subject of many researches. The fact that the amounts of nitric and nitrous acids in rain bears certain relations to the prevailing weather conditions was shown not long ago by Mr. V. G. Anderson, in a paper read before the Chemical Society at Melbourne, and an outgrowth of this paper was the inauguration of systematic observations at sixteen stations well distributed over Australia, under the auspices of the British Association. Each observer is provided with a glass rain-collecting gage and a set of specially prepared stoppered bottles in which samples of rain-water are forwarded to Melbourne for examination. The analyses of these samples will be correlated with meteorological data collected by the commonwealth meteorological bureau.

Auroral Displays and "Strays."—The standing committee of the British Association on radiotelegraphic investigations is gradually acquiring a rich fund of knowledge on the subject of the natural electric waves in the ether variously known as "strays," "Xs," "static," etc. The work of the committee depends upon the coöperation of a large corps of observers in various parts of the world. According to the last annual report of the committee, officers at the wireless stations of the U. S. Signal Corps in Alaska have been making systematic observations to determine whether there is any connection between strays and auroral displays. Observations were made at six stations during the winter of 1914-15. Various types of aurora were watched, but nearly all the observers reported that the appearance or disappearance of auroras caused no unusual disturbances. Observations had not, however, been made in October or November, the best months for such investigations.

A British Tribute to Wilkes's Work in the Antarctic.—Capt. J. K. Davis, who was sailing master of the "Nimrod" during Shackleton's first expedition, and of the "Aurora" during Mawson's expedition, recently paid a visit to New York City. In an interview published in the *New York Times* he declares that the charts of Wilkes, the American explorer whose work in the Antarctic has been the subject of so much controversy, proved to be of inestimable value to the Mawson expedition. Many of Wilkes's soundings and other observations were checked up and found remarkably accurate. "On one occasion," says Capt. Davis, "if it had not been for his accurate map we should have had to turn back, for there seemed to be no opening for the ship. But his map showed one, and we finally found that it was barely wide enough to allow the 'Aurora' to pass through. Wilkes has been maligned by later explorers, but in my estimation he accomplished a wonderful amount of work, with his motley array of misfit ships, without steam or any of the modern improvements."

The Pollution of Shellfish-producing Tidal Waters in Maryland and Virginia has been the subject of thorough investigation by the Public Health Service, and is discussed at length in Public Health Bulletin No. 74, just issued. The author emphasizes the fact that partial knowledge on this subject has caused shellfish (*i.e.*, especially oysters) to be looked upon as a rather dangerous article of food, and the result has been injurious to the shellfish industry. A complete investigation, by defining and localizing such danger as exists, should result in "restoring confidence in a safe, cheap, nutritious and delicious food product, the output of which may be almost indefinitely increased under intelligent legislation." The recent investigation shows that of the 400,000 or 500,000 acres of shellfish-producing areas in the waters of Maryland and Virginia, about 2,000 to 2,500 acres, or one-half of 1 per cent are found to be polluted. Moreover, comparatively small parts of the polluted beds are actually in use. An important problem is to prevent further pollution of the waters available for the industry. Maryland has laws to accomplish this end, but Virginia, though more seriously affected than any other state by injury to her shellfish industry, has none.

Electricity

Rectifying Alternating Current by an Air Blast is the subject of a patent recently granted to two Americans. The invention proposes to surround a rod electrode, spaced from a coöperating disk electrode, with an air blast at a pressure of about 10 pounds to the square inch. It is claimed by the inventors that by directing the air blast along the path of the discharge it is possible to rectify successfully an alternating current of a potential as high as 50,000 volts. Any desired amount of rectification may be obtained by varying the pressure of the air blast.

The Music Optigraph, which is believed to be a complete solution of the difficulties hitherto encountered in the teaching of music, is the invention of B. F. Miessner, a student of electrical engineering at Purdue University, Lafayette, Ind. It consists of staff lines printed on a dull, semi-transparent sheet of celluloid or pyrolin, behind which is arranged a bank of lamps operated by flashlight batteries. A keyboard is provided in which the light-touch push-buttons control the bank of lamps. The latter, when illuminated, cause solid red ovals to appear on the lines and spaces of the staff sheet in any combination desired.

Water Heater of the Induction Type.—A departure from the general principles involved in electric water heaters is found in a recent device of American conception, which makes use of the inductive action of electricity. The new water heater consists of a cast-iron core through which passes the liquid to be heated, laminated U-shaped sections surrounding the ends of the core on both sides, and a primary coil through which passes the exciting current. Since the primary coil is wound with heavy wire, insulated with asbestos, the heating unit is practically indestructible. The new heater can be applied to almost any system of liquid circulating system where the liquid is to be heated.

Electric Gas Detector.—C. M. Means, an inventor of Pittsburgh, Pa., has developed an ingenious form of electric gas detector for use in mines. It consists of two glowers placed vertically side by side, and inclosed with gauze and glass. To use the detector a button is pressed and electric current from a primary or storage cell heats the glowers to a dull red. In air both glowers are of equal luminosity, but in inflammable gases one of them assumes a brighter glow, while the other is duller. While primarily intended to detect the presence of 2 per cent or more of gas, it is said that it has been used successfully in detecting percentages as low as 0.5.

Flood-Lighting of Shooting Traps.—The advent of flood-lighting has lengthened the day both in the field of industry and play. Brightly illuminated tennis courts are now too common to attract even passing attention, but an electrically illuminated shooting range is still somewhat of a novelty. Peculiar interest therefore attaches to the flood-lighting of the traps of a gun club in Boston, which enables the gunners to shoot clay pigeons at night with quite as much success as by day, if not more, since it is said that there is less diversion of one's attention from the work in hand. The lighting equipment consists of eight 250-watt stereopticon lamps in special reflectors, each giving 67,000 candlepower.

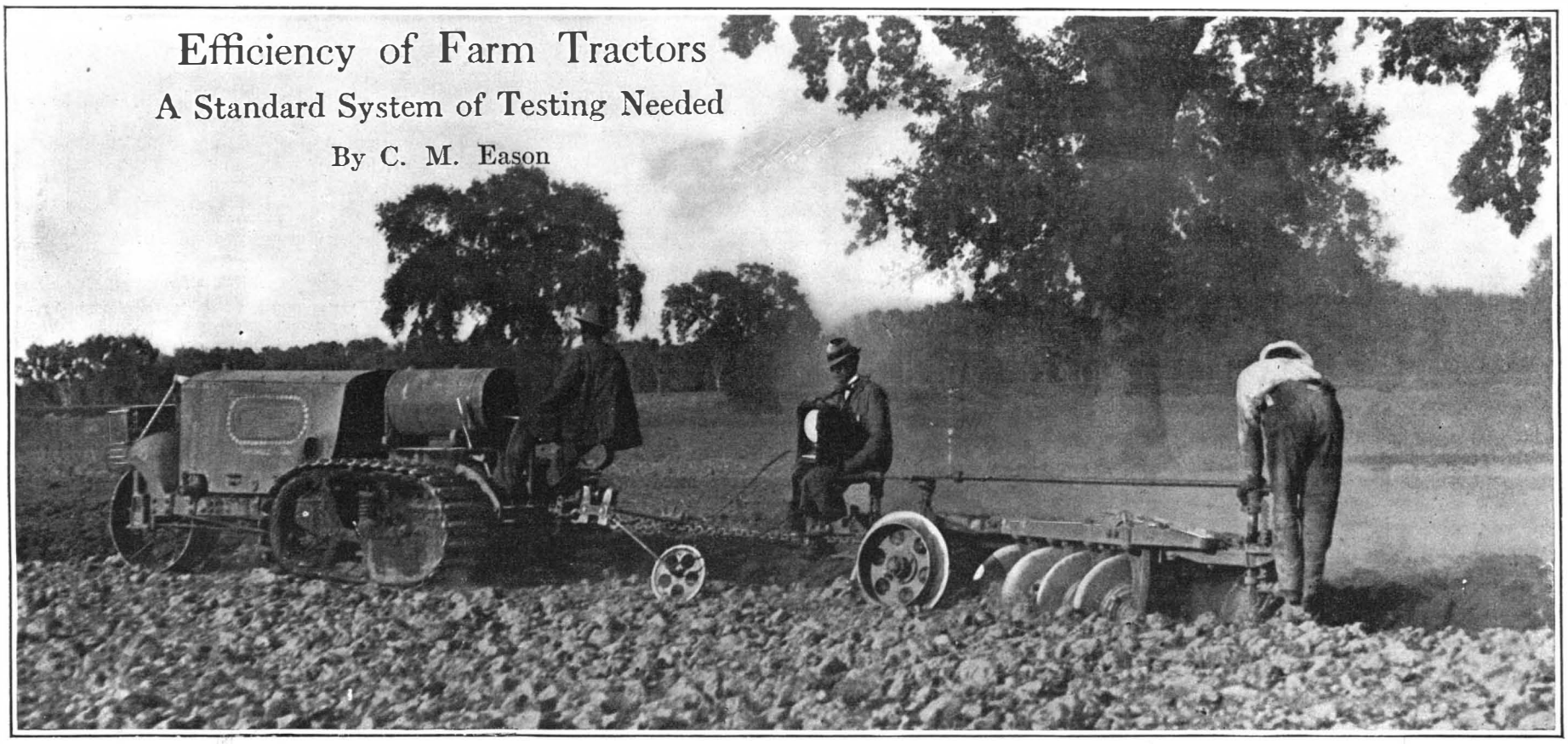
The Electric Vehicle in South Africa.—Speaking generally, the success of the electric vehicle should be greater in South Africa than in most parts of the world, because of the fact that gasoline costs there three times as much as in the United States and, roughly, twice as much as it does in any other country. The great drawback to this type of vehicle, so far as South African markets are concerned, is its very high cost compared with that of the ordinary gasoline vehicle. In view of the fact that South Africa, on the whole, is comparatively speaking very badly off for electric power, on account of the large number of towns without electric-lighting systems, the sale of the electric vehicle would be restricted practically to the small number of towns where electricity is available.

Electrical Work in Germany.—The huge demand the war has made on Germany's supply of copper has resulted in a disconcerting situation for German electrical companies, and it is doubtful if even at the present moment they have succeeded in overcoming the shortage of copper by the use of suitable substitutes. Copper is essential to all electrical work. While zinc is being largely employed in Germany as a conductor of electric currents, this metal is far from being satisfactory in this connection. Zinc cables cost from 100 to 150 per cent more than cables of copper when of the same cross-section; but since the conductivity of zinc is considerably less than that of copper, and even lower than that of aluminum, the cost of zinc cables and bus bars over copper is far greater than the foregoing figures would indicate. Zinc is being used in preference to iron, for the latter metal is always a material of last resort, particularly when alternating currents are to be handled.

Efficiency of Farm Tractors

A Standard System of Testing Needed

By C. M. Eason



Tractor and disk plow being tested with a dynamometer. The plow has six 26-inch disks cutting 52 inches wide and 10 to 12 inches deep in California gumbo rice land

THE present method of rating tractors varies with the personal opinion or preference of the different tractor builders. Consequently no one standard system of rating has been adopted, with the result that prospective purchasers, and possibly even the builders themselves, find it very difficult to make an accurate comparison of the various tractors built. Tractor builders all agree that some standard method of testing and rating tractors is greatly needed and that the same method should be applied to all makers of tractors so that the ability of each would be clearly and comparably defined. The development of the gas tractor industry has been so rapid that at yet very little standardization along these lines has been possible. With the tractor ratings established according to the individual preference of the designer, or builder, it is only natural that a considerable number of methods are in common use.

Methods commonly followed are to express the rating in terms of horse-power, both at the draw bar and of the motor; to specify the number of plows that can be handled under normal conditions; to give the pounds pull at the draw bar together with speed in miles per hour and motor horse-power, or to rate in pounds pull only. Each different method of rating is subject to considerable variation depending upon the basis on which the rating is figured. Most tractor builders try to state a figure—whether horse-power, number of plows, or pounds pull—which will express the nominal capacity of the tractor. Some, however, rate at the absolute maximum capacity under ideal conditions, while others rate considerably lower than nominal capacity.

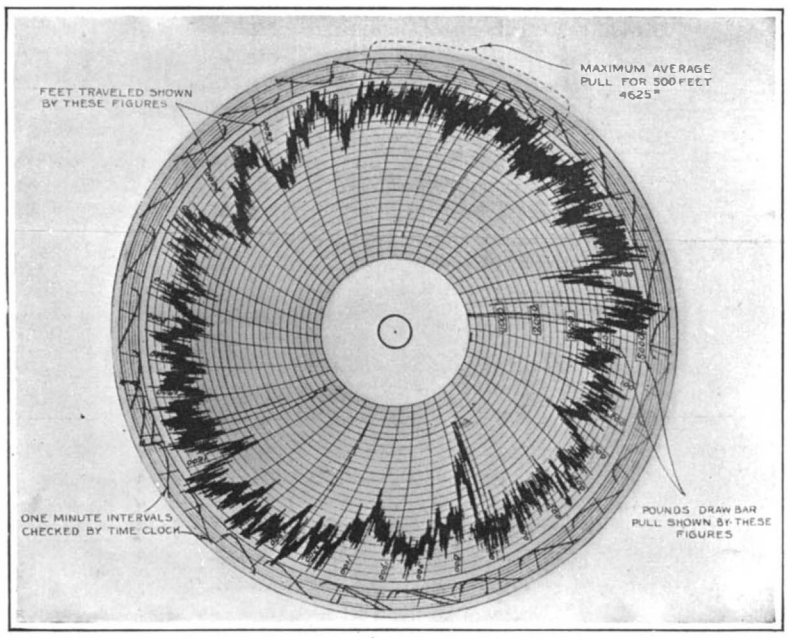
This makes the accurate comparison of one tractor with another almost an impossibility for the average tractor buyer, since he has no means of knowing what basis has been used in establishing the rating. To eliminate this uncertainty, the United States Department of Agriculture has invited the tractor manufacturers and engineering societies interested in tractors, to coöperate in developing a suitable method of testing with a view to establishing a uniform standard rating for all farm tractors.

Motor Rating

To ascertain the horse-power of the motor is a comparatively simple proposition. There is not much argument on this subject, it being generally conceded that the rating for the motor should be taken at its normal working speed, and should represent the actual power that can be delivered at the belt pulley of the tractor.

Motor tests can easily be made by providing a suitable belt-driven prony brake or electrical absorption dynamometer which accurately measures the delivered horse-power.

The only open question as to motor rating is whether to rate at the maximum power delivered or at a figure somewhat lower, which would indicate the normal working capacity and maximum feed efficiency.



Record made in the tractor test shown above

Testing a tractor and plow

Power Losses

With the power and efficiency of the motor determined the next question is, how much of the motor's power is available at the draw bar in the form of horizontal draught for operating plows and other agricultural implements?

There are two principal factors governing the draw bar pull of a tractor. The first is the efficiency of the transmission system, and the second the rolling resistance, or the amount of power required to propel the tractor over the ground.

For practical purposes, friction losses and tractive losses can be considered as a single factor, and the draw bar rating established by tests made with a recording draught dynamometer. For purposes of close analysis of tractor performances, however, it is certainly advisable to consider each separately.

Transmission Efficiency

To determine the power losses in the transmission system, or to measure the power available at the drive wheel, it is necessary to apply some sort of resistance directly at the rim of the drive wheel, and arrange to measure the power output. One method suggested is a modification of the apparatus used for testing locomotives and is shown diagrammatically in Fig. 1. It consists primarily of an endless track or plank roadway on which the drive wheels of the tractor rest. A brake is provided for varying the resistance of the endless track.

The tractor is held in place by a recording dynamometer attached to the draw bar and suitably anchored. To ascertain the traveling speed a recording tachometer is driven from one of the track supporting rollers. The dynamometer record would show the rim pull of the drive wheels and the tachometer record the speed. From these records could be figured the draw bar horse-power by the following formula:

$$\frac{\text{Draw Bar pull in pounds} \times \text{speed in M. P. H.}}{375} = \text{D. B. H. P.}$$

The usefulness of this method in testing tractors would be limited to machines heavy enough to secure maximum traction on the hard surface of the tracks. Most tractors of modern design would not weigh enough to insure maximum traction on a plank surface, therefore cleats engaging with the mud lugs or grousers on the tractor wheel would be essential. To insure proper meshing of the mud lugs provision would have to be made to allow varying the spacing of the cleats on the track. For round wheel tractors a more accurate method would be to use a band brake on the bare wheel rim as shown in Fig. 2. In case the mud lugs were not detachable the wooden blocks could be attached to the wheel rim instead of to the brake band. The apparatus shown contemplates arranging the brake so that the drive wheels rest on a scale platform in order that the static and running load on the drivers may be determined.

The dynamometer indicated in this sketch is arranged to record the draw bar reaction due to the re-

sistance of the brake band and is made so that the revolution of the drive wheel actuates the dynamometer chart, thereby recording the number of revolutions or the peripheral travel of wheel rim. A clock is provided to record the time automatically. In this way an accurate reading of pull, distance and time can be had.

Draw Bar Pull

Either of the above methods would determine accurately how much of the motor power was available at the drive wheel rims and would be extremely valuable in studying the friction losses of different types of transmission systems. The actual pulling ability of the tractor, however, could not be determined by these methods owing to the fact that the power required to propel the tractor varies with practically every machine. Weight, wheel diameters, widths of wheel face, load distribution, whether round wheel or endless track, front wheel or rear wheel drive, are all factors governing the rolling resistance. These factors are varied to such an extent that there are no two tractors, now on the market, that, under similar conditions, would show the same rolling resistance.

The problem, therefore, of determining the draw bar pull, or draw bar power of a tractor, is one of making draught tests with the tractor propelling itself and pulling a steady load. The most important consideration is to have the conditions of the ground surface uniform for a series of tests. The power loss due to rolling resistance varies with the firmness of the soil, moisture content, whether sod, stubble, or newly plowed, etc.

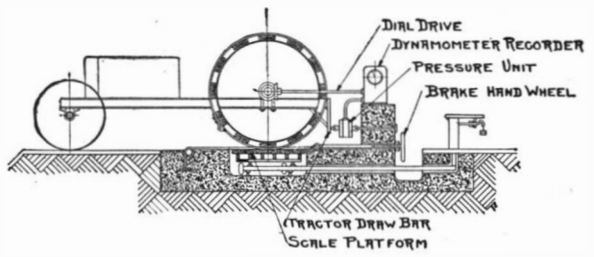


Fig. 1 Arrangement similar to that used in testing locomotives

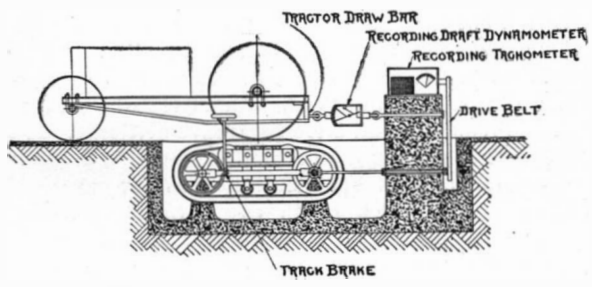


Fig. 2 Using a band brake on the bare wheel run

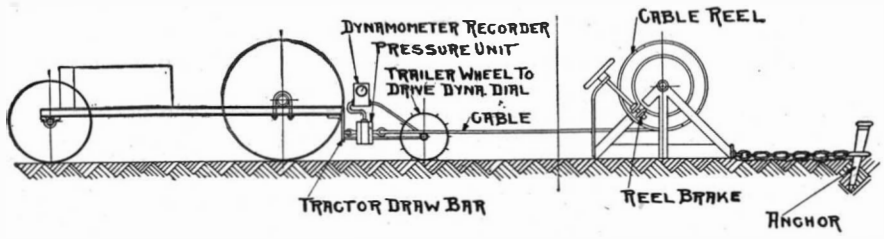


Fig. 3 Providing an even drag with a cable reel

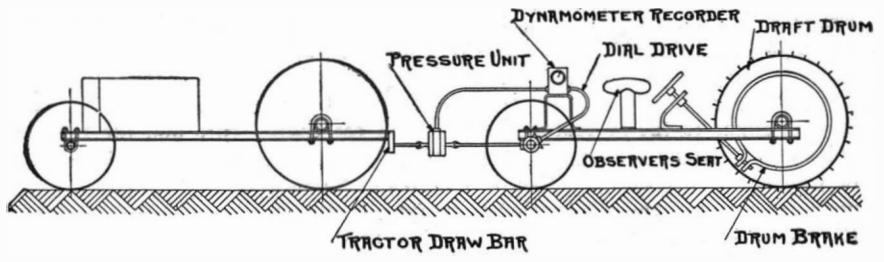


Fig. 4 Dynamometer hitched between the tractor and the load

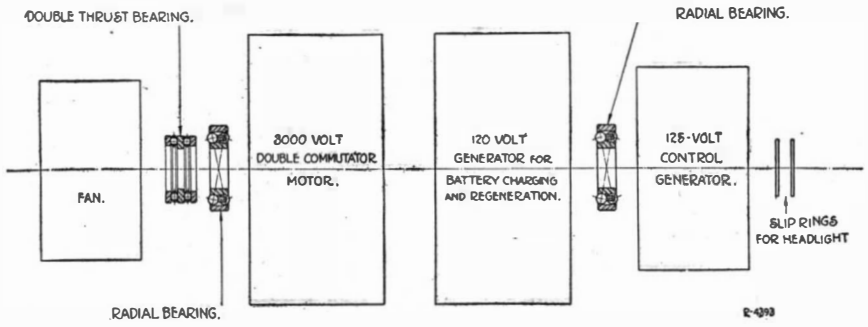
A brick or macadam road surface would offer the lowest rolling resistance, but since most tractors are designed to pull by virtue of the grip of the grousers or mud lugs on the ground, a great many machines could not be tested to full capacity on this sort of surface because of their inability to secure maximum traction. A dragged and rolled dirt road would probably be the most satisfactory surface on which to conduct the tests. It would, however, be necessary to re-surface after each test so that the tractor following would have the same footing and rolling resistance. To provide an even load it has been suggested that a cable reel, similar to a hoist drum, be provided with a variable brake and that the tractor be hitched to the cable by means of the recording dynamometer as shown in Fig. 3. The cable reel could be suitably anchored as shown in the sketch, or the end of the cable could be anchored and the whole reel pulled along on skids. The advantage of the latter scheme would be that the man operating the drum brake could be near the tractor and could more accurately adjust the load to the capacity of the tractor. The limitation of using a cable is that the test runs would necessarily be very short. A cable large enough

(*Concluded on page* 105)

Five-Thousand Pound Capacity Ball Bearings for Electric Locomotive Service

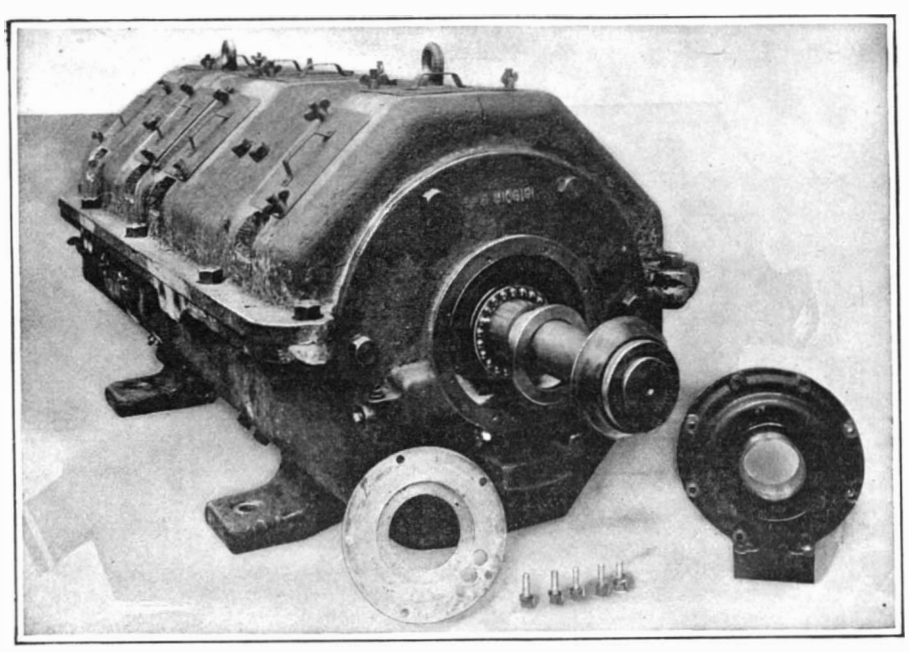
ONE of the interesting features of the equipment installed on the 282-ton electric locomotives now operating on the Chicago, Milwaukee & St. Paul Railway, which were described in the SCIENTIFIC AMERICAN, Vol. CXIII, No. 19, page 391, is the motor-generator set which provides low voltage current for the control of other auxiliaries. This set consists of a 3,000-volt direct current series motor, having a double winding and two commutators for operating in series at 3,000 volts; a small generator for furnishing control current at 125 volts; a 120-volt generator furnishing current for regeneration and for charging storage batteries on passenger cars, and a blower of 13,000 cu. ft. capacity for ventilating the main driving motors. On account of the several functions performed by this set, dependable performance is of vital importance to the operation of the locomotive. Besides furnishing current for control, it is also used in connection with regeneration on down grades, for lighting the locomotive interior, and for supplying the low voltage incandescent headlight which takes current from collector rings at one end of the set.

In order to assure safety and to obtain the highest possible efficiency and to secure bearings which will operate successfully under extreme weather conditions such as very high temperature in the summer and weather as cold as 40 deg. below in the winter, these sets are equipped with ball bearings of American manufacture. The shaft upon which the revolving element is carried is supported by two radial ball bearings and protected from shocks due to end thrust by double thrust ball bearings. The accompanying diagram indicates the location of the bearings and shows that the set overhangs at both ends. The set is installed longitudinally in the locomotive cab and the thrust bearing takes up shocks incidental to switching and train handling. The bearing has a capacity of over 5,000 pounds at the normal speed of the set. As can be seen from the illustrations, these ball bearings are of liberal size, the radial type being over 10 inches outside diameter and having a bore of 4.7 inches. The weight of these bearings is 33.5 pounds. The balls and races are made of Swedish crucible steel and the ball retainers are of bronze. Forty-two of the locomotives—which, incidently, are the largest in existence—are either in operation or under construction, and employ a total of 84 of these ball bearing sets.

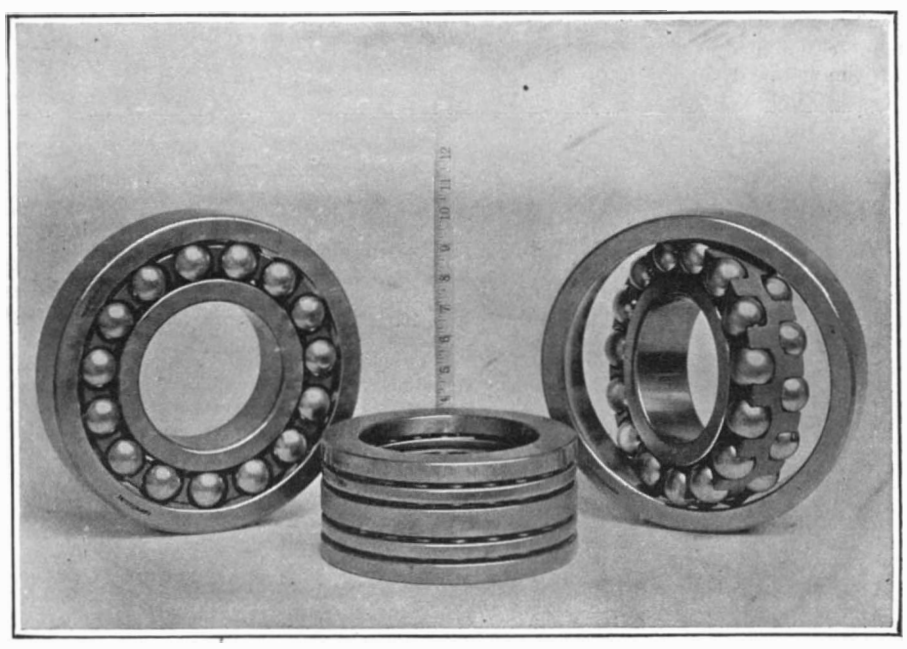


Arrangement of the various machines which go to make up the complete motor-generator set

The Chicago, Milwaukee & St. Paul locomotives are now operating over a distance of 220 miles between Deer Lodge and Harlowton, Mont., and it is probable that by November 1st the entire electric zone between Harlowton, Mont., and Avery, Idaho, will be in operation. These trains operate over the mountain divisions of the transcontinental lines of the railroad, crossing three mountain ranges and reaching an altitude on the Rocky Mountain Divide of 6,350 feet. Two freight units, one operating as a pusher, are designed to haul a 2,500-ton train over the maximum grade of 2 per cent at about 16 miles per hour. Passenger trains weighing 800 tons are hauled at about 60 miles per hour on level track, and are taken over all grades up to 1 per cent unassisted, at speeds of about 30 miles per hour. On the down grades all locomotives return power to the system for use by other trains, thus relieving the air brakes of heavy duty. This feature insures a uniform speed on down grades, increasing safety of operation and greatly reducing wear on brake shoes, wheels and the track. Another advantage obtained in regeneration is the saving in power, which amounts to approximately 15 per cent of that used for hauling trains.



Motor generator set of one of the world's largest electric locomotives



Ball bearings used in the motor generator set, showing their large size

The Dean of Bacteriologists

A Brief Survey of the Contributions of Elie Metchnikoff to Human Welfare

WHY does a man who has attained a hearty middle age of fifty or thereabouts so often fall away in vigor and succumb to one of the various forms of "old age" before he is seventy? Some of these vigorous quinquagenarians survive to a hale and hearty ninety years; a select few attain the privilege of informing the reading public, from the proud pedestal of a round hundred, how they did it. But those who have escaped the special dangers of youth, and have arrived at this mature age of fifty, ought to be able to realize much more frequently than they do something like the full "lease of life." There seems to be no reason why they should not avoid the usual rapid senile changes or weakness of old age, and survive, as the select few actually do, to something like one hundred. The causes of this senile change, and the way to defeat their operation, were the subjects of the last studies of the great Russian scientist, Elie Metchnikoff, as well as those by which his name is known to the man in the street.

It would be interesting to compile a list of the popular distortions of scientific reputations. Metchnikoff is the sour milk man, Darwin the fellow who claimed that men were descended from monkeys; Newton was the chap who lay under a tree watching the apples fall off, Franklin was the one who walked the streets with loaves of bread under his arms, and flew kites in thunderstorms; and so on, *ad infinitum*. These distortions manifest themselves in the relative weights which the public assigns to the several achievements of the individual, they extend far beyond the proverbial "street" in which they are born, and have a permanent effect upon the action of the public mind in its distribution of the niches in the hall of fame. Once a scientist is so branded in this fashion, there is no escape for him.

So in spite of his multitude of other contributions to the advancement of science, Metchnikoff is condemned to be handed down to posterity as the man who advocated a diet of sour milk, the man who thought that people should live to a hundred and fifty and then died at seventy-one himself. Perhaps, after all, the popular estimate will be justified. Certain it is that if at any time within the past ten years the distinguished Russian had been requested to name his most fruitful activity, he would without hesitation have selected his longevity researches. So perhaps we can do no better than notice them first here.

It is well known—has been known these many years—that one cause of the weakness and liability to succumb to disease so characteristic of the human frame after the age of fifty, is hardening of the arteries. This results, not merely from use of alcohol to the degree commonly designated as drunkenness, but from the most ordinary habitual indiscretions of diet, which many people feel themselves quite unable to avoid. Still, from the physician's standpoint, they can be avoided, and with them their result; hardening of the arteries is a perfectly understood phenomenon, presenting no new problem.

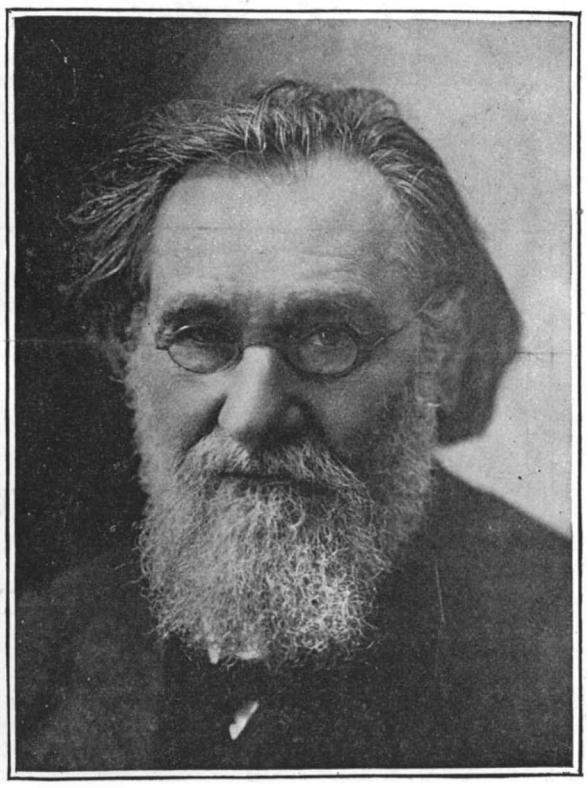
Metchnikoff sought another cause of senile changes, and found it in the continual absorption of poisonous substances produced by the decomposition in the large intestine of considerable quantities of partly digested food. It was with the view of preventing the formation of these poisons—he conceded that the presence of incompletely digested matter in the intestines was not to be prevented—that he introduced the use of sour milk, prepared with lactic ferment.

The fundamental idea, as is well known, was suggested to Metchnikoff by observations made upon the manner of life of the Bulgarian peasants, in connection with their reputed longevity. His methods of experimentation are perhaps less widely familiar. He employed animal experiment freely, using for the purpose a few monkeys, but mainly a species of tropical fruit-eating bat. These creatures possess a very short intestine, containing a very small number of bacteria, of very few kinds. By regulating their diet in his laboratory in Paris, Metchnikoff was able to eliminate the bacteria completely from their alimentary canals. He was thus in possession of adult mammals, in fundamental structure quite analogous to the human, of similar habits of nutrition and internal chemistry, but absolutely free from those intestinal bacteria which he supposed to be the cause of senile poisoning in man. He was then in a position to test his views to any extent whatever. He could make a given experiment on a collection of bats, each of which was different, in bacteriological condition, from each of the others; and he could then compare intelligently the results with respect to the health and general chemical condition of his subjects. It was on these experiments that he based his claims of the scientific value of his sour milk preparation; it was shown definitely that its presence in the intestine curtailed the numbers and the ravages of certain undesirable bacilli.

As so many discoverers do, Metchnikoff probably over-estimated the importance of his treatment. It cannot be said that the secret of longevity is discovered. The Russian's dream of a life span of a century and a half, closing in a peaceful euthanasia no more to be dreaded than the nightly falling asleep, remains a dream. But it is not to be questioned that he developed new and powerful methods of attacking the problem, new therapeutic agents of indisputable value. Perhaps the situation may best be summarized by saying that Metchnikoff has revealed *one* of the factors in longevity, but that we must await other discoveries before his optimistic forecast will become a reality.

Metchnikoff's study of the causes of senile decay was, however, merely an episode in a career which included more productive and more suggestive activities. If one thing more than any other deserves specific mention in his epitaph, it is his discovery and investigation of phagocytosis—which is, in effect, the destruction of pathogenic microbes by the corpuscular bodies of the blood—even though he was led thereby into somewhat heterodox views on the subject of immunity. In this connection we may well quote from the substance of an address made by Metchnikoff himself at the Darwin celebration at Cambridge in June, 1909.

The recognition of the derivation of man from animal ancestors, he said, and of the complete analogy and continuity of development connecting the organic structure and the internal chemistry of man with those of the other animals, had made the study of the diseases



Prof. Elie Metchnikoff

of animals a necessary feature in understanding the ailments of human flesh. The universal Darwinian principle that the mechanisms and processes found in the bodies of plants and animals, including man, must have been selected in the course of the struggle for existence, and perpetuated because of their utility, leads at once to speculation as to the value of the process known as inflammation, and of the related phenomenon of the phagocytes, or "eating corpuscles," which wander from the blood into the inflamed tissues.

Consideration and investigation of these questions led Metchnikoff to the discovery that the office of the phagocytes is to "engulf" and destroy the germs of disease; that they are the great protectors of the animal (including the human) body against the malignant bacteria and other germs which enter so freely into cut and contused surfaces, and would infallibly establish diseases of various sorts and dangerous characters were it not for the inflammation there set up. This inflammation, in fact, is neither more nor less than a stagnation of the circulation at the affected spot, provoked by the automatic nerve-system, and designed to precipitate at the seat of danger thousands of phagocytes. These pass out of the stagnant blood, through the walls of the minute blood-vessels, and at once attack and destroy the germs which fall upon the exposed surface of the wound—from the air, from dirty objects of contact, from the adjoining skin itself.

The utility of the process of inflammation, and its gradual development in an ascending scale of the animal kingdom, according to the standard principles of evolution, were demonstrated by Metchnikoff over twenty years ago, and must, as we have said, constitute his chief claim to human service. His great work on immunity from, infection with and protection against germ diseases marks an epoch in this branch of pathology. He was one of the earliest to recognize the tremendous role played by the various microscopic organisms in human life, and may well be considered the dean of bacteriologists.

Professor Metchnikoff was born in 1845, near Kharkov, Russia. He studied at Geissen and Munich, and has served on the staffs of the Universities of Petrograd and Odessa. In 1882 he severed all his public connections, and gave himself over to private research; and it is since that date that his important contributions have been made. He was long recognized as the leading physician of France, and was head of the Pasteur Institute for over twenty years prior to his death. He had been suffering from heart trouble for some time, and his death was no surprise to his acquaintances.

Hunting for Oil Used in Shoe-Shining Preparations

SHOE-BLACKING owes its peculiar aromatic odor, faintly suggestive of the deep woods, where spruce or hemlock needles pad the ground, to an oil which is manufactured from these same kinds of needles. Similar oils are obtained from the foliage and small twigs of various cone-bearing trees, and find use for a number of purposes. In Europe the finer of these oils are used extensively as perfume in soap. They are common components of liniments and other medicinal preparations. Cedar oil is chiefly used in the preparation of insecticides, and, to some extent, in making liniment.

Investigations of the yield and the value of the oil obtainable from some of our southern and western trees have been made by the Forest Service, partly with a view to the possible utilization of waste material left after lumbering in the National Forests. In these investigations long leaf and western yellow pine leaves produced the most promising results, but the needle oils obtained from these pines did not surpass the already firmly established spruce and hemlock oils. The large quantities of needles and twigs on Forest Service timber sale areas are not only a sheer waste, but also form a special fire hazard. An increased market for leaf oil would make possible the utilization of some of this waste material.

The industry, though small, is fairly old in the United States. The value of the annual production of needle oil is about $50,000. Black and white spruce and eastern hemlock produce very similar oils, 40,000 to 50,000 pounds annually, worth 45 to 60 cents per pound. Red cedar produces 15,000 to 20,000 pounds of oil, having the same value per pound as the spruce and hemlock oil. A few other species furnish the rest of the conifer-leaf oil produced in the United States. Besides the home product, small quantities of needle oil are imported from Europe. In most cases these oils have a pleasant odor. A few are disagreeable when first distilled but become pleasant with age.

The greater portion of the oil produced in the United States is distilled by small farmers in New England during the winter months when farm work is slack. In 1912, a Seattle firm began the distillation of leaf oil from western red cedar on a large scale, but found that at the going market value of 40 cents a pound the oil scarcely repaid the cost of production. It was chiefly used in manufacturing an insecticide containing 35 per cent of cedar oil and 65 per cent of an absorbent made from the finely ground shells of peach pits. Four dollars and a half to five dollars and a half per ton, depending on the oil content, was paid for the leaves and twigs.

A firm at Grant's Pass, Oregon, has patents covering methods for utilizing western yellow pine needles in the production of fiber after the oil is removed by distillation. Their plant consists of wooden tanks with steam connections with a daily capacity of 2,000 pounds of raw material, from which ten pounds of oil are obtained and, by suitable treatment, the spent needles produce a long, tough fiber that can be woven into fabric or mixed with hair and made into mattresses.

The distillation process is very simple. Steam is passed through the needles, usually at atmospheric pressure. The oil volatilizes and the mixed vapors pass into a cooling apparatus where condensation takes place, leaving a layer of oil and a layer of water. Distillation by steam under pressure is more rapid and produces more oil. Cutting the needles in small pieces before treatment increases the oil production. Young trees yield most. Trees growing in the open contain more oil than those in a dense stand. The winter and spring months are best for oil content.

Strategic Moves of the War, July 20th, 1916

By Our Military Expert

THE most marked changes which have come about in the hostile battle lines during the week are to be found on the Eastern line, where, west by north of the Dubno sector the Teutonic forces were compelled to fall back to the line of the Lipa. This surrender of ground became necessitated by the power of the thrust immediately to the northward, which threatened, if successful, to turn the Teutonic position, leaving them with no strong line of defense upon which to take position in case of hurried ejectment.

Far to the southward, beyond Kimpolung and Kirlibaba, the Russian advance under General Letchitzki is reported to have penetrated into Hungary at least one day's march. There is little cause to doubt the truth of this report; everything considered, there seems to have been a decided collapse of Austrian strength throughout the extent of their lines. Wherever German troops and German administration has been able to throw forces into the breach, the Russian tide has been stemmed, whether temporarily or otherwise. But Germany's available reserves are by no means inexhaustible, and severe drains have been made upon them not only by the powerful Russian advance but by the demands of Verdun and the Somme sector in France. By the thrust into Bukovina by greatly superior forces, the Austrian line has been compelled to extend itself about 170 kilometers—about 106 miles. The very least number of men required to hold such a line in even indifferent strength is in the neighborhood of 3,000 per mile; the new line therefore calls for the placing of more than 300,000 men along it. Austria has never dared weaken her lines to the northward, and therefore the only recourse must have been to call upon general reserves, of which, it is believed, there is a great scarcity. It has been conservatively estimated that the Teutonic losses on the Eastern line since the opening of the offensive in early June have amounted to nearly 500,000 casualties. Russia has taken in prisoners alone at least half this number, while killed and wounded—removed from availability for the present at least, make up the balance.

The comparative ease, therefore, with which Russia has been able to extend her lines throughout Bukovina and into the Carpathians should be directly traceable to the paucity of enemy reserves. Austria cannot let go farther north, for her dominating ally would never permit the safety of her own lines to be jeopardized thereby; and there are few men available for help.

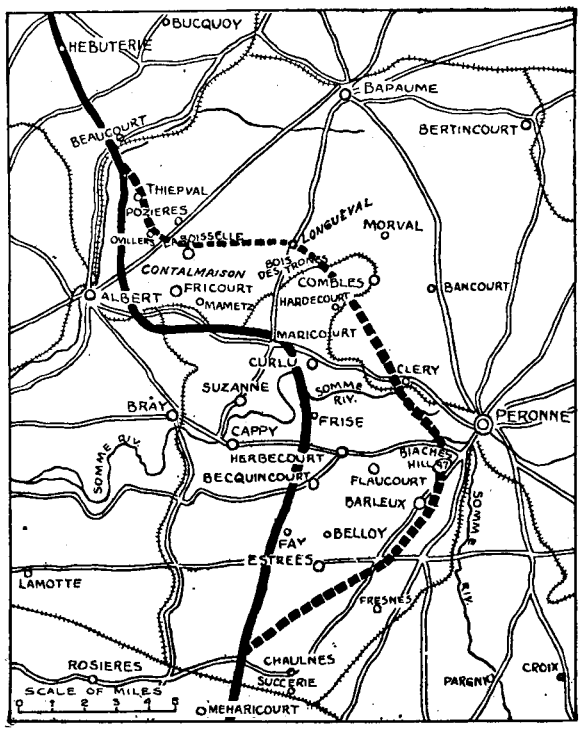
A glance at the accompanying map shows two important facts: The Russians are gradually inclosing the important railway point of Lemberg in a great segment of a circle. The horns are still a considerable distance away, but with each westward mile gained the menace becomes more imminent. And to the northward, the armies of the Czar are doing the same thing with regard to Kovel, although territorially on a smaller scale. But the danger is the same in both cases.

Already one important Austrian line of supply has been cut by the occupation of Delatyn by the Russians. This line leads directly to Lemberg; and already the Russians are almost due south of Lemberg, not so very far, considering the shattened condition of the Austrian organization, from the next railway line. Should any material Russian gains accrue, in westerly distance, Lemberg would be practically turned, and with it, the southern communications, leading to the same condition which obtained when Russia was pressing on to Cracow early in the war—with the exception of the fact that the present Teutonic position to the northward would be in far greater danger than then, for then the line was not so far to the east, nor in such precarious position should a Russian advance succeed.

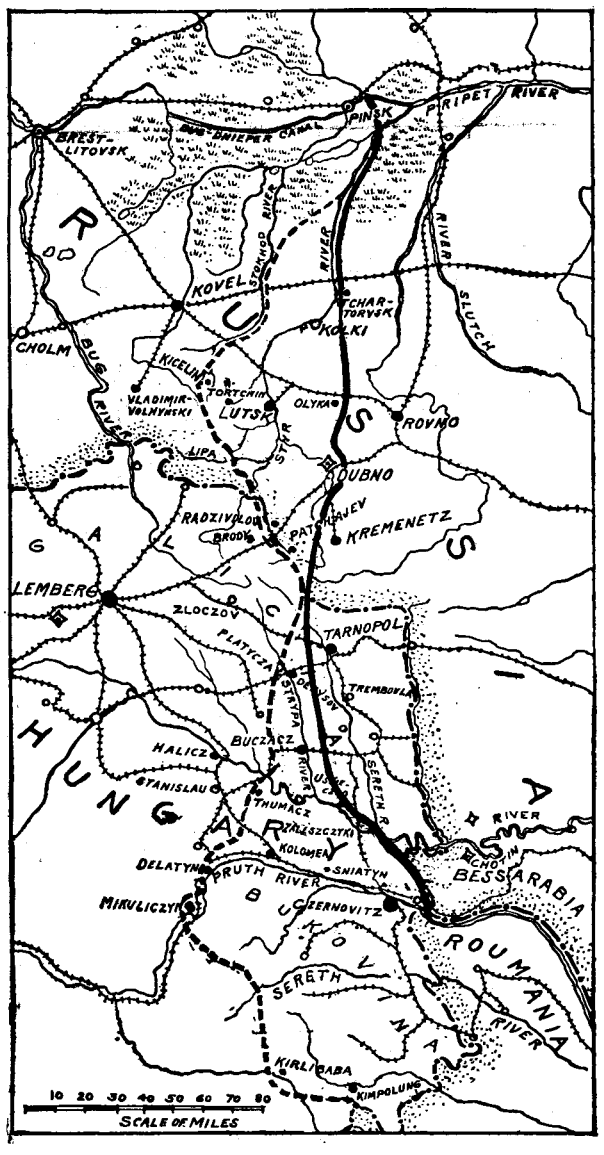
West of Lutsk, the Russians are nearer the Vladimir-Volhynski railway than they are to Kovel. Should the Russians gain this line it would open up another and easy line of advance upon Kovel, from the south; also Lemberg would be threatened from the north as well as from the south and the lines of the Teutonic allies would be in imminent danger of severance.

It remains to be seen whether the line will hold, whether the Russian power is great enough to reach Kovel. Their losses have been tremendous in the assault; but Russia's enormous man-power reserve is apt to be a telling factor. In any event, she can much better afford to lose men than can her opponents. Once Kovel is reached, however, the simplest understanding of strategy demonstrates that the entire line south of the marshes must retire without delay to the line of the Bug, the only defensive line remaining in the sector. In case of such retirement, the Austrian line must be withdrawn to Sokal and the river district northeast of Lemberg, practically, retirement to the Lemberg line.

But if this retirement is made, the situation with regard to the German line north of Pinsk cannot be ignored. No longer will it be possible to place reliance in the difficult terrain of the marshlands to protect the flank, for the Russians would then be so far in rear of the German lines that a problematical disaster, a piercing by the Russians of the German lines, would be apt



The Franco-British offensive
The heavy line shows the former front and the dotted line the advance up to July 20th.



The offensive in Galicia
The advance of the Russians and their original position shown by dotted and solid lines respectively.

to result in a disaster to the Germans of the first order. Necessarily, the German line would have to retire at once, probably to the line of Brest-Litovsk-Grodno-Rovno and the Baltic. It would be no time in which to take half measures, for with such Russian gains, the territory held to the northward by the Germans would be a sort of *cul-de-sac*, from which only with the greatest difficulty could their forces be extracted in case of a major reverse. This is by no means saying this will happen; it is merely the pointing out of the territorial limitations if such a condition should come about.

Undoubtedly the Russian "come-back" has made a powerful impression upon Austria-Hungary, especially Hungary. The German staff, which directs the destinies of the Central Empires, had so definitely announced to their people that Russia was out of the war when the Czar's forces were hurled back to the line they have just left, that it was taken for fact. The impression created after the first Russian steam-rolling operation was checked and bundled out of Galicia, one of confidence that it was all over but the shouting, had the effect of causing an equal reaction when it was demonstrated that Russia had again girded her powerful loins for another major offensive. But that there is much, if any, truth in the reports that Austria is on the verge of suing for an immediate separate peace, is far beyond credence. Austria's confidence may be sadly shaken, her reserves may be reduced to an oppressive minimum—but she herself is not so far greatly hurt territorially, and the lesson of reverse has not been definitely driven home as yet, for Russia has not gained enough ground to bring such a conviction about. The domination of Kaiser Wilhelm over Kaiser Franz Josef—nationally—is too great for Austria to be willing to make any such attempt; Germany would not stand for it for a moment; and the interests of the two empires are so inextricably bound together that such a contingency is scarcely worthy of a moment's consideration.

On the western line, in the Somme sector, the English have, by dint of ceaseless hammering, pushed forward their line to the northward until it runs almost east and west from Orvillers to Longueval, and eastward to include the *Bois des Trones*. The latest available dispatch announces that the Germans, by powerfully organized counter attacks, have retaken the town of Longueval, but the general alignment remains about the same. These Allied gains have had the effect of widening the salient which has been dented into the German lines, implying that the general scheme of operations is to first gain as much distance to the front as possible, widen gradually the apex of the salient to a material distance, then pound a new salient from the squared face of the first.

It is a costly operation, but from the character of the long deadlock which existed, losses are to be expected if such an attempt is made. The German positions have been so organized that a minimum of men could hold them, the principal reliance of defense being placed in the defensive value of the positions, the curtain of fire behind the advanced lines of attack and the sweep of numberless machine guns. In general, there are three lines of defence; in some places the third line has been reached by the offensive, and passed, only to be halted by field forces and local reserves in open battle. It has been suggested that the English plan of campaign has been so thoroughly worked out, that so much insistence has been placed upon assaulting troops limiting their advance to the definite line laid out for them, that there is an element of overcaution in the whole affair. Perhaps it is true; but the task of breaking a deadlocked line is so monumental a one that until a sufficient breach is made in the line it may be the only way.

It is believed by many, however, that if the objective of the offensive is gained, if a gap is torn in the line sufficiently broad to permit the pouring of troops through it, a collapse of defense will come so suddenly as to be startling. The line may be sagged to the breaking point and it may there hold; but if it is once broken the assaulting armies will then be so far in rear of lateral positions that hasty retirement to new lines of defense a considerable distance to the rear will be the only alternative remaining to the defenders.

Possibilities of Porto Rican Turmeric Industry

THE turmeric grows wild over a considerable portion of Porto Rico and is fairly abundant. The natives call it "gengibrillo," or "little ginger," and it is also known as "gengibre amargo," or "bitter ginger." It is used by natives as a dye for the fibers from which hammocks are woven, for ribbons, cloths and the like. While the text books state that the yellow dye obtained from the root is not fast, the natives seem to have been able to render it fairly permanent. Fabrics and hammocks dyed by them do not fade.

The root is not gathered in any quantity as yet. If there is a market for it, a supply will be easy to obtain. Neither quotations nor dealers' addresses can be given because the root has not been utilized commercially.

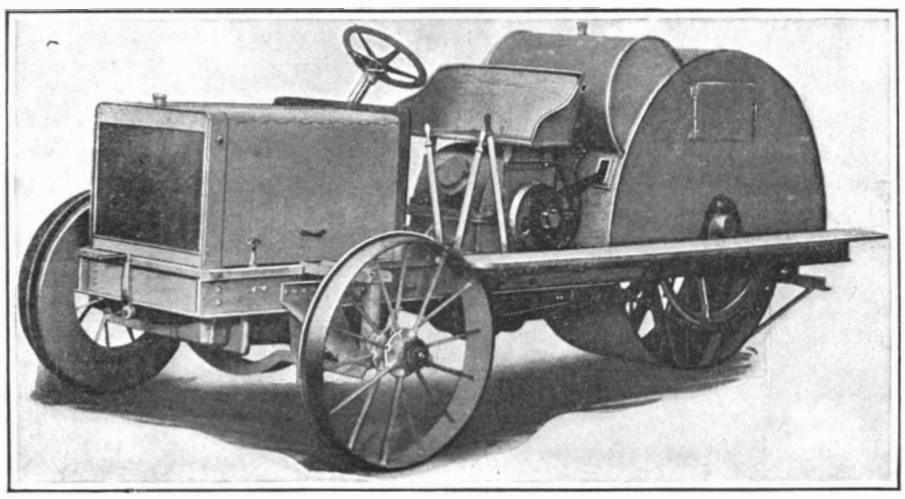


Fig. 1 Modern medium weight tractor, embodying automobile design principles

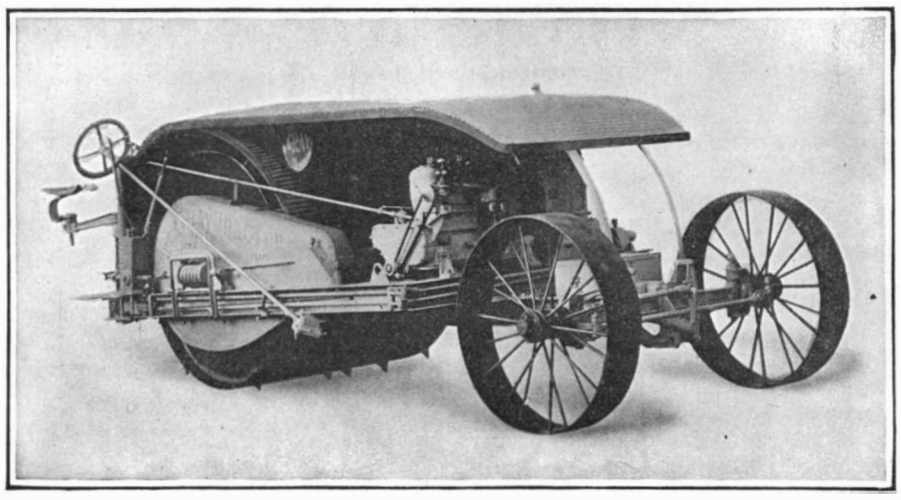


Fig. 2 Distinctive light tractor design using wide driving drum

Modern Agricultural Tractor Designs

By Victor W. Pagé, M. S. A. E.

THE general application of mechanical power to the farmer's work has increased the productiveness of the fields and has greatly enlarged the scope of the farmer's activities. It has been estimated that in one farm task alone, plowing, more energy or power is expended than in the combined manufacturing establishments of the world for a similar period.

The first plowing engine was built in 1858 and utilized steam power. It was capable of drawing eight plows through prairie sod at the rate of 3 miles per hour. The first tractor propelled by an internal combustion engine was placed on the market about 23 years ago, but it was a very clumsy and inefficient mechanism when compared to the more highly refined steam tractor of that period. The development of the practical internal combustion motor and the reduction in its weight and increase in power output made possible by the growth of the automobile industry had its influence on improving the gasoline engine for tractors. The introduction of the practical internal combustion traction engine was of even more importance to the farmer than the invention of the reaper and binder or the threshing machine. It supplied agriculturists with a power that could be applied to good advantage to work that called for the expenditure of much energy. It also supplied a convenient and easily portable power plant that could be used economically for driving many of the machines necessary to carry on farming operations profitably.

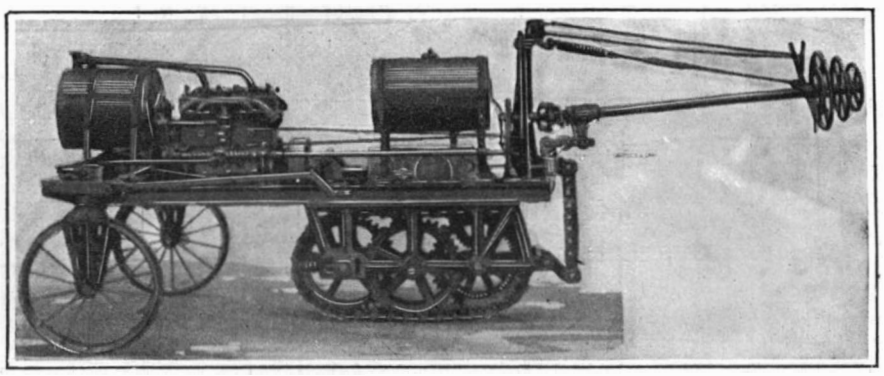


Fig. 3 The "steel mule" tractor is attached to implements just as animals are, and is controlled from the seat of the trailing vehicle

Space is not available to go into the comparative merits of animal and mechanical power or to outline the reason why horses, mules and other draft animals are destined to give way to the gas tractor on even very small farms. Some of the lighter tractors which are now available can be made to do any work that the animal can and at the same time are suitable for much work where horses cannot be used at all. A farmer cannot afford to feed and house all the year round the number of horses necessary to do the work of a 50 horsepower gas tractor if the conditions are such that the machine may be used to advantage.

Before describing the improvements in light tractor design it may be well to sum up briefly the requirements of the ideal, all-purpose tractor:

First, it should be universally adaptable so that it can do all kinds of belt or drawbar work. It should be just as well adapted for running farm machines requiring power as it is for hauling plows, harrows or loaded wagons.

Second, the ratio between power and weight and the arrangement of components are important things to consider. If the tractor is too light it will not have the required traction effort between the drive wheels and the ground, and considerable useful power will be dissipated in slippage. On the other hand, if the machine weighs too much it will pack the soil and will not be practical for use on soft ground. It is evident that more power will be required to move a heavy weight over the ground than a tractor of less mass, and the power needed is especially noticeable when climbing hills. Authorities familiar with tractor design seem to agree that the weight distribution should be such that the greater part of the total weight should come over the traction members.

Third, as much contact area between the traction members and the ground should be provided in order to avoid loss of power through slipping and packing of the soil due to concentration of much weight on a limited bearing area.

Fourth, the tractor should have change-speed gearing which will provide at least two forward speeds and should include reversing gear so that it can be driven backward as well as forward. The power transmission from the engine to the traction members should be positive and care should be taken in the designing so that there will be minimum loss through gearing friction.

Fifth, it is desirable that the engine be capable of operating on the cheaper liquid fuels such as kerosene, distillate and others of the more plentiful products of petroleum. The rapidly increasing cost of gasoline makes it imperative to use other fuels and as the tractor engines, for the most part, are heavy-duty constant-speed types, no difficulty should be experienced in using kerosene.

Fig. 4 Medium weight three-wheel tractor of modern design, pulling three-bottom gang plow

Sixth, the tractor should be designed with specia reference to the work it is to do and should be constructed of sufficiently good materials so that the weight may be kept within reasonable limits and combine strength with lightness. The tractor should be easy to start and the various controlling functions such as gear shifting, clutch operation and steering should be simplified and control levers so proportioned as to be handled without requiring great muscular exertion. It is evident that the simple tractor will be easier to understand, maintain, and repair. In fact, the simpler designs will be more easily operated by the average farm hand. The construction should be so arranged that automatic steering can be secured when doing certain classes of work, such as plowing, so that the engineer or operator may utilize part of the time in handling the plow shares.

Quite a number of the tractors of modern design answer nearly all of the above requirements. The mechanism is simple and the relation of the parts is good from both theoretical and practical consideration. In most of the machines of to-day useful lessons have been drawn from current automobile practice. It is a safe statement that the tractors which more nearly incorporate the ideal requirements enumerated are those which follow the rules of practice established by automobile builders. In essential elements the automobile and gas tractor are similar, though, of course, the parts and detail arrangement must be modified for the heavier and slower machines. One of the marked tendencies in tractor design is to use multiple-cylinder power plants.

When the gasoline tractor was first evolved a large horizontal single cylinder stationary engine was mounted on the supporting frame or chassis that was the same as those used on steam tractors. At the present time multiple cylinder engines are used because these have less vibration and the general arrangement of the chassis parts have been altered to some extent. In the steam tractor the drive gearing was generally exposed and was composed of a gear train of heavy cast iron gears with practically no finish. At the present time not only the gearing but other parts of the transmission system, such as the clutch, are encased and protected from grit and dirt. Cut alloy steel gears running in oil and operated in practically the same way as change speed gearing on automobiles have replaced the heavier forms used on the early machines. Pressed steel and standard structural forms such as channels and I-beams are replacing the combersome cast frames of the early tractor. Whereas the earlier machines used plain bearings at all parts, the modern tractors use ball and roller bearings which not only have longer life than the plain babbitted type, but which offer a material saving in power, as well as reducing the repair expense by

keeping the parts in the proper relation longer. While it would take at least half a day for an experienced man to pour a babbitt bearing and fit it properly, the anti-friction bearings, which are interchangeable, can be easily removed and replaced by new ones in much less time.

Considerable interest is being displayed in the three-wheel constructions. In fact most of the light tractors that are being offered this year are of the type having a single traction member and two steering wheels. The type shown at Fig. 1 is one of recent construction and may be considered fairly representative of this class. The front wheels are 36 inches in diameter with a 6-inch face, while the main drive wheel is 62 inches in diameter with a 24-inch face. The engine is a four-cylinder, four-cycle motor, capable of delivering 25 horse-power belt pull and 15 horse-power drawbar pull at approximately 900 revolutions. The cooling system includes a flat tube radiator through which water is circulated by a 6½-inch centrifugal pump. Ignition is by magneto. The transmission provides two speeds ahead and one reverse. The low speed is 1¾ miles per hour—the high speed, 2½ miles per hour. Larger sprockets are furnished which may be easily fitted and which will give higher speed.

This tractor will pull two gang plows or two disk harrows. It is capable of hauling two binders or two drills and will trail three to five grain wagons. It will pull two manure spreaders or an eight-foot road grader. It has sufficient belt power to operate a 32-inch separator, a silage cutter, corn shredder, corn sheller, circular saw, feed grinder, water pump, hay baler or grain elevator. The machine is easily controlled as it is handled very much as an automobile. Especial attention is directed to the thorough inclosure of all gearing in dust-proof, oil-tight cases.

The machine shown at Fig. 2 is practically a three-wheel type, though the drive is through an extremely wide traction member or drum. This not only provides good traction, but carries the weight on a great area. It is said that this tractor can turn in a 22-foot circle and that the machine can be maneuvered equally as well on plowed land as on hard ground. One advantage of the three-wheel forms described is that the mechanism is simplified owing to the elimination of the differential. The power plant is a four-cylinder, four-cycle auto type engine. Owing to the compactness of the machine it is specially adapted for orchard cultivation. In all features except the wide drive drum this tractor follows conventional practice.

The tractor shown at Fig. 3 is distinctive in construction inasmuch as it is a practical motor-driven machine that can be hitched to any horse-drawn implement and operated from the seat of the vehicle the tractor is drawing, just as though it was being drawn by horses. This is an advantage because it can be used in connection with the horse-drawn implements already in the farmer's possession. The tractor is controlled by means of three wheels and a lever on the end of a long column which consists of three lengths of tubing, one inside of the other. This control column is connected with the tractor through a universal joint and can be swung at will to any position desired. The middle wheel is the steering, the small wheel in front of the steering wheel operates the clutch and the remaining wheel actuates the gear-shifting apparatus. The carbureter control which is used to regulate the engine speed is in the form of a lever projecting in front of the clutch control wheel. The motor gives 30 horse-power on the belt. It is a four-cylinder, four-cycle heavy duty type following approved automobile practice.

The distinctive feature is the traction member or "crawler," as it is called, which consists of an endless chain apron of metal plates, each link of which is a single piece of metal connected to the adjoining piece by means of a connecting pin having a large bearing surface. Either malleable iron or vanadium steel links may be furnished. The endless chain is driven by a manganese steel gear located at the rear of the traction tread member, while the center part is supported by two flanged idler wheels which prevent the tread from slipping sideways and at the same time guide it properly. The advantages of the track-laying type of drive, where the machine is to be used in soft ground, are now well recognized, as the weight of the machine is distributed over so large a surface that it will not sink even into soft ground. The ground pressure is lighter than that of a man. The area to support the weight is so large that a horse would need shoes having an area of 1 square foot each attached to its four feet to enable it to tread as lightly on the ground. The turning radius is 8¾ feet so the machine will turn in an 18-foot circle. The width of the front tread is adjustable from 3 feet, 9¼ inches to 6 feet, 9¾ inches, which allows of cultivating rows 30 to 48 inches wide.

The type of light tractor shown at Fig. 4 is equipped with a double cylinder engine of the two-cycle type which is attached to the frame by a three-point suspension. The cylinders are of 5½-inch bore and 7-inch stroke, and the engine is rated as 22 brake horse-power in belt and 15 drawbar horse-power. Heavy duty ball bearings are used at all points except the engine and rear axle bearings. This engine has been designed to use kerosene or other low grade fuels after an initial start is obtained on gasoline. Oil is used for cooling the engine, this providing a non-freezing medium that will not deposit scale in the radiator or rust the metal parts. A tractor of this kind can do the work of eight big, strong horses. It can be used for all forms of belt work and will pull all types of horse-drawn implements. It has a capacity for drawing three 14-inch plows under average conditions. It is a very simple machine and easily operated as it steers just like an automobile when not following a furrow and is self-steering when plowing. The machine weighs 6,000 pounds.

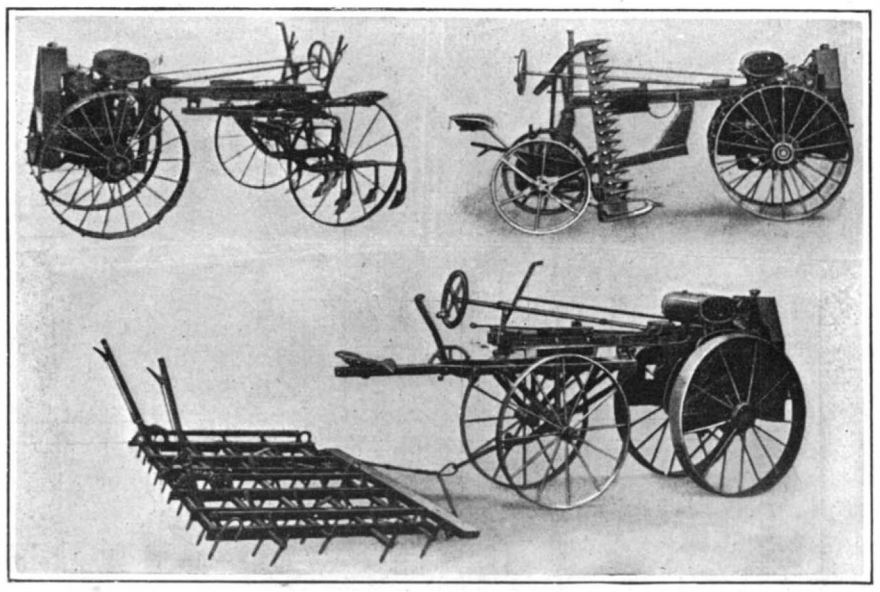


Fig. 5 Light motor cultivator that is also adapted for attachment to other farm implements. Has drawbar pull equal to a team of horses

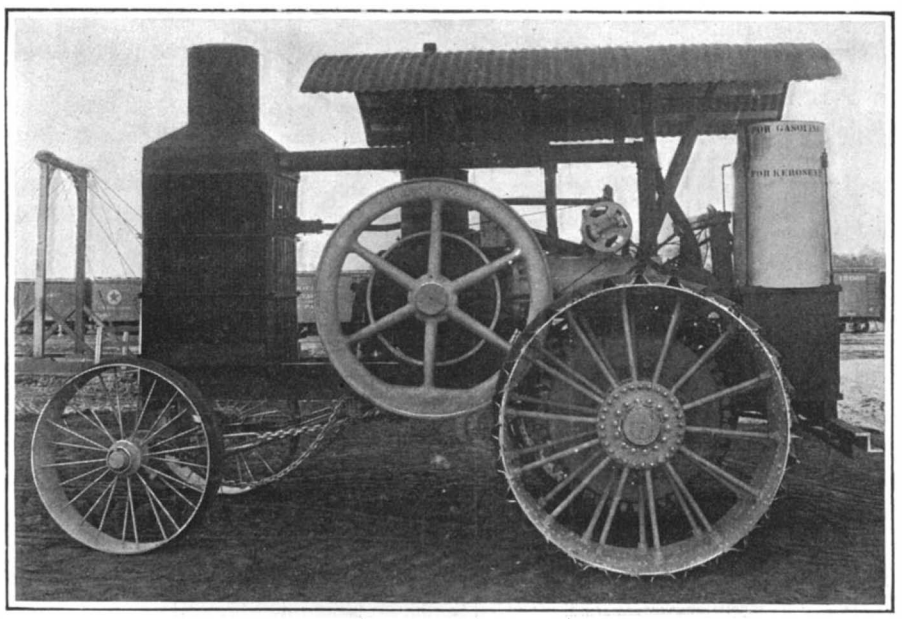


Fig. 6 Typical example of medium weight tractor that has not been changed in construction for some time because it is well adapted to the work for which it was designed

The motor cultivator shown at Fig. 5 is a form of tractor, though, of course, it is not adapted for heavy work. It is designed so that it can be hitched up to a mowing machine, hay rake or harrow just as well as to the cultivator attachment. The power plant is a two-cylinder, V-type motor, of 3½-inch bore and 5-inch stroke. The transmission is through worm gearing, housed in a dust-proof oil retaining case. The gearing is supported by ball bearings. The tractor attachment is supported by the two driving wheels which are 40 inches in diameter and 5 inches face. Cleats are provided on the wheels to obtain greater traction. The machine weighs but 1,000 pounds and is easily handled by the 12 brake horse-power motor which has a drawbar pull about equal to an ordinary team of horses. The machine may be driven at any speed desired up to 4 miles per hour and is easily guided from the driver's seat on the trailing vehicle. A special wheeled trailer is provided to carry the driver when operating machines that have no seat and for driving the tractor from place to place without transporting the implements.

Very little change has been made in the design of the standard type medium and heavy weight tractors which are represented by the form shown at Fig. 6 and which have been used for nearly a decade. These are invariably of the four-wheel pattern and are intended for use on large farms. The smaller machines described, which are more economical to operate, are, of course, able to do any of the work that would be necessary on the small farm. The latter type of machine has been the one most needed, but it is only within the past two or three years that any serious attempt has been made to produce tractors for the use of the agriculturist farming a small acreage. These sell at prices ranging from $400 to $1,000, and so they cater to a large demand.

The Current Supplement

THE use of the automobile in military operations has been attracting much attention, for it has been very apparent that this motive power is absolutely indispensable in any modern army. The paper on *Automobiles in The Great War*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT for July 29th, No. 2117, contains matter of the greatest interest to everyone, as it reviews in a most competent way the types of vehicles used by the Allies, and considers the various technical features in view of actual experience in war work. *British Methods of Handling Coal* describes the machinery used in England for handling coal in bulk at the shipping docks, and affords an interesting comparison with American methods, which were described in the SUPPLEMENT some time ago. The article is profusely illustrated. *Shadow Pictures by Parallel Rays* tells of a method for producing negatives without a lens, that is useful for many purposes. It is accompanied by several interesting illustrations. *The U. S. Government Libraries at Washington* gives much useful information in regard to the great collections of printed matter at the National Capital, which are of inestimable value to the public. The paper on *Modern Views of the Sun* is concluded in this issue. *Bird Houses* gives many useful hints on the construction and care of these shelters for our feathered friends, and it is illustrated by a number of practical diagrams. *The Determination of the Resistance of Ships* reviews recent investigations bearing on the question of designing suitable power for different classes of vessels. Other articles of value in this issue are *X-Rays and the Theory of Radiation; The Relation Between the Cutting Efficiencies of Tool Steels and Their Brinell or Scleroscope Hardness; The Process of Case Hardening and Feeding the Firing Line.*

China's Density of Population

ABOUT 95 per cent of the population of China is confined to one third of the area of the country, with a density of 200 to the square mile. Five per cent of the population inhabits 65 per cent of the area, with a density of 10 to the square mile. Lack of transportation facilities and the absence of adequate means of protection account for the sparseness of settlement in the outlying dependencies. About 40 per cent of China's population is in the provinces south of the Yangtse River, with a density of 230 to the square mile. This territory has twice the area of the original 13 states of the American Union and four times the population.

There are no wheeled vehicles in use south of the Yangtse except of the Canton and Yunnan Railways. There are therefore no roads in this section. Rice is cultivated throughout this area, and transportation is over paths rather than roads or by boats or water ways. In this section the water buffalo and oxen are the only animals used on the farms, and goods are carried on the backs of men rather than on pack animals or wheeled vehicles, except where the few miles of railways are in operation.

Rice is often spoken of as the staple article of food for the whole of the Chinese people, yet tens of millions of people in China have never seen or tasted rice. Vast areas of the country north cannot grow rice.

In the outlying dependencies, constituting 65 per cent of the total area of China, the density of population is less than that of our Middle West of the United States.

The Heavens in August

Uranus Well Positioned for Observation

By Prof. Henry Norris Russell, Ph.D

THE present month affords an unusually good opportunity to observe the remote planet Uranus, which comes to opposition on the 10th and is visible all night long. The planet is so faint, on account of its great distance from the sun, that it is barely visible to the unaided eye, even on the clearest and darkest nights, and this makes it hard to find unless some convenient pointer happens to be near by in the shape of a brighter object. This requirement is excellently met this year by the fourth magnitude star Iota Capricorni. Though this is not shown on our sketch map, it may easily be found just below the intersection of a line drawn from δ Capricorni towards β Capricorni with another drawn from ε Pegasi through β Aquarii, and extended southward to cut the first line.

Uranus, which is only about one-fifth as bright as this star, may be found on August 1st almost north east of it, at a distance of a little over 1½ degrees. The planet is moving slowly eastward, and a little to the south, and by the first of September it will be almost due north of the star and three-quarters of a degree distant. It appears like a star of the sixth magnitude, and can be very easily seen with a field glass, though rather difficult without optical aid. Its motion,—which is the only thing observable without a telescope in which the planet appears to differ from the host of fixed stars—can be detected within a few days by comparing sketches made on successive nights.

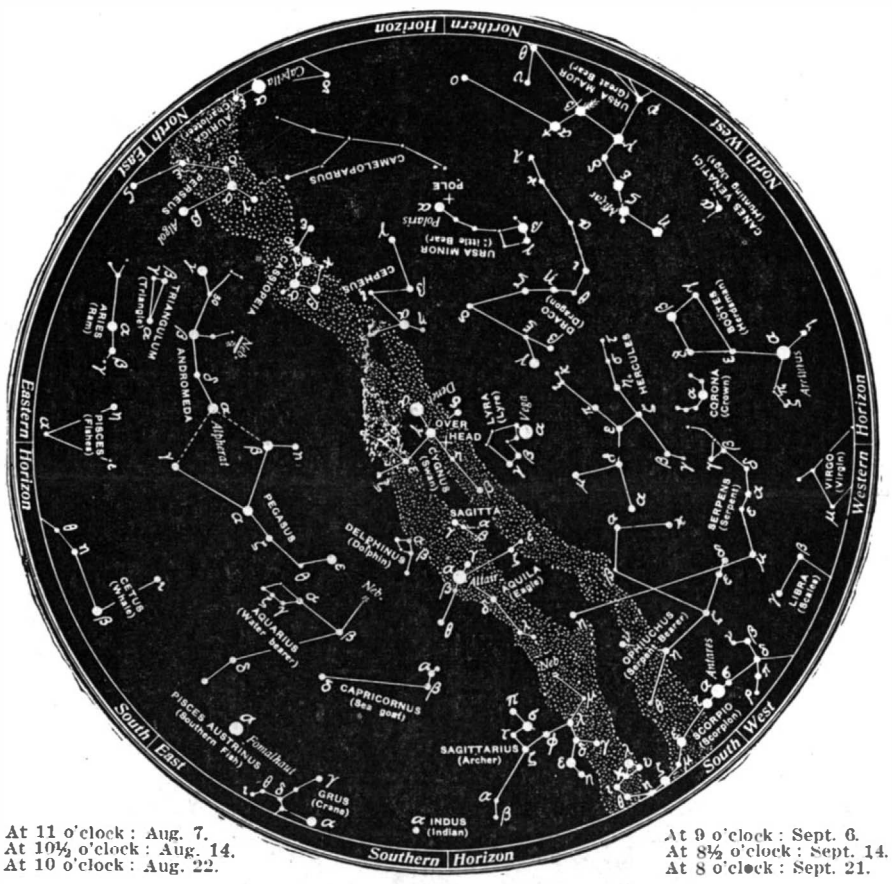
To see the disk of the planet, which is only 3½ seconds of arc in diameter, requires a telescope of three inches or more in aperture,—and the difference between the planet and the neighboring stars is not at all conspicuous to the untrained eye, unless a much larger instrument is available. The satellites are visible only with a few of the very largest telescopes.

With an opera-glass, or even a small telescope, Uranus seems a very insignificant object—which probably explains the remarkable fact that, though actually visible to the naked eye, it escaped detection for more than 150 years after the invention of the telescope. But in reality the planet is a very large body, far exceeding the earth in all respects. Its diameter is not easy to measure accurately, for at this enormous distance a very minute error in the setting of the micrometer screw with which the observations are made will alter the calculated diameter by several hundred miles. From the average of the result of the best observers, however, it appears that the mean diameter of the planet is about 32,500 miles, a little more than four times the earth's, and rather less than half that of Saturn. Though exceeding the earth nearly seventy-fold in bulk, Uranus "weighs" only 14½ times as much as the earth—that is the total quantity of material in the larger planet, though greater than that contained in the earth, is by no means proportional to its bulk. The density of the planet works out just about one-quarter of that of the earth, or about 40 per cent greater than that of water. This is only about one half the density of the ordinary surface rocks and soils of our own planet, so that it is very probable that Uranus, like Jupiter and the sun,—which, though of very different sizes, are all three of very nearly the same density,—is not a solid mass, like the earth or moon, but a ball of liquid or even gaseous matter, very hot throughout its interior.

The enormous mass of the sun enables it to throw out such a flood of heat that even its surface is intensely incandescent; but Uranus, like Jupiter and the other major planets, has already cooled down on the surface,—if indeed it ever was very hot there, which we do not know—and shines only by reflected sunlight.

The sunlight at this great distance from the sun (1,850,000,000 miles at the present time) is little more than 1/400th as bright as at the earth's distance. In consequence, the disk of Uranus looks very much fainter than a portion of that of one of the nearer planets of the same apparent size. Thus Mars, which, when on the far side of the sun and near its greatest distance from the earth, appears of very nearly the same angular diameter as does Uranus at its best, is then well above the second magnitude, and looks more than fifty times as bright as does Uranus. The actual disparity in reflecting power is, however, in the other direction,—as may easily be seen when it is considered that Mars, even at its greatest distance from the sun, is less than one-twelfth as far away from it as Uranus, and is consequently exposed to a sunlight about 160 times as strong,—so that, if its surface reflected the sun's rays as powerfully as does that of Uranus, it would appear three times brighter than it actually does.

When the comparison is made, not between Uranus and another planet, but between its observed brightness and the maximum theoretically possible for a perfectly white sphere as big as the planet, it is found that Uranus reflects about 60 per cent of the incident light. This is far greater than the reflecting power of any ordinary rocky or earthy materials, but is very similar to that of terrestrial clouds. It is therefore probable that the visible surface consists of clouds of some sort, as seems also to be the case with Jupiter and Saturn, and is to be expected in all these cases if the constitution of these planets really is as we have inferred above from their low densities.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: August 29.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

Our map represents the appearance of the whole vault of the sky to an observer lying upon his back and looking straight upward,—so far, indeed, as the appearance of this hollow vault may be represented on a plane.

The various points of the compass are marked upon the edge of the map, and if it is held in a vertical position and turned about its center till the point of the compass toward which one is facing comes to the bottom, it illustrates the appearance of the skies as one looks straight forward in that direction.

With these hints, the veriest novice may acquaint himself with the summer constellations.

Right overhead (at the hours and dates printed below the map) is the great Cross of Cygnus, its longest arm stretching from northeast to southwest along the Milky Way. To the westward is the bright star Vega, in Lyra, and to the southward Aquila, with the less brilliant but still conspicuous Altair.

South and southwest of this, beyond the finest region in all the Milky Way—at least for observers in our latitude—lies Sagittarius, with the little inverted Milk Dipper as its most prominent configuration. Farther west is Scorpio, now setting, and above this are the tangled outlines of Ophiuchus and the Serpent which he carries.

The brilliant orange star Arcturus is low down, a little north of west, and above it are the little semicircle of the Northern Crown and the keystone-shaped figure which is the most conspicuous feature of Hercules. The Great Dipper is low in the north-northwest, and the Dragon and the Little Dipper (Ursa Minor) are above it,—the latter extending as far as the Pole Star, which is due north. Perseus is low in the northeast, with Cassiopeia and Cepheus above him, in the Milky Way.

Andromeda and Pegasus stretch along a great region of the eastern sky. Below them are Aries and Pisces, with part of Cetus just risen. Aquarius and Capricornus are well up in the southeast, and lower down is the isolated star Fomalhaut, in the Southern Fish.

The Planets

Mercury is an evening star this month, but is rather unfavorably placed, being south of the sun, so that, even at the end of the month, he sets at 7:30 P.M. and is almost lost in the twilight.

Venus is a morning star, and very conspicuous, rising at about 2:10 A.M. on the 1st, and a little before two o'clock at the end of the month. She is at her greatest brilliancy on the 9th, but her brightness changes but little during the month, being ten times that of Sirius throughout the interval.

Telescopically she appears as a wide crescent, which can easily be seen with the smallest instruments. She is easily visible with the naked eye in full daylight if one knows where to look for her.

Mars is an evening star in Virgo, setting about 9 P.M. in the middle of the month. On the 26th he is about two degrees north of the bright star Spica. Though considerably fainter than the latter, he surpasses all the other stars of the constellation. Jupiter is a morning star in Aries; at least, though past quadrature, he does not rise until nearly 11 P.M. at the beginning of the month. By its close, when he appears above the horizon at nine o'clock, he may fairly be said to be observable in the evening as well.

Saturn is in Gemini, just past conjunction with the sun, and rises about 3 A.M. in the middle of the month. Uranus is in Capricornus, and directions for finding him have already been given. Neptune is in Cancer, just past conjunction with the sun, and practically unobservable.

The moon is in her first quarter at 4 P.M. on August 6th, full at 7 A.M. on the 13th, in her last quarter at 8 A.M. on the 20th, and new at 10 A.M. on the 28th. She is nearest us on the 12th and farthest off on the 24th. High tides may again be expected on the former of these dates, and especially a day or two later, since, at least on the Atlantic coast, the dates of greatest range of the tides lag about this amount after the full or change of the moon.

In her circuit of the heavens the moon passes near Mars on the 4th, Uranus on the 13th, Jupiter on the 18th, Venus on the 24th, Saturn and Neptune on the 25th, and Mercury on the 30th.

At the conjunction with Saturn an occultation takes place,—the planet, as seen from Washington, disappearing behind the moon's bright limit at 3:03 A.M. and reappearing on her opposite side at 4:05.

This occultation behind the thin crescent of the waning moon will be worth getting up to see if the weather is favorable,—though at the planet's disappearance it will be very low, even for observers in the easternmost part of the country.

Southport, Connecticut, July 17th, 1916.

Activity in Japanese Shipyards

MARCH advices to the Bureau of Navigation from Tokyo show that the shipping built in Japanese yards during 1916 will amount to about 160,000 gross tons. All the shipyards are flooded with orders sufficient to keep them busy during the next two years, and projects for the establishment of two new shipyards are under consideration. Japanese yards, however, are confronted with some difficulty in securing a supply of steel, imports of steel from Europe having almost entirely stopped some time ago so that Japan must look to the United States for steel shipbuilding materials.

Sharks, Man-Eating and Otherwise

The Present Status of a Very Old Subject of Controversy

EVERY summer, as the bathing season progresses, argument waxes among retired sea-captains, market fishermen, and other near-scientists, as to whether a shark will attack a man. At the present moment events along the New Jersey coast have given this subject a timeliness beyond that it ordinarily possesses, and aroused much public interest in the matter. The true scientist—he who knows a hundred and fifty species of shark by their Latin names, and can state offhand from what species a given tooth was taken—smiles at this discussion, for he knows that it arises, like so many other controversies, from a difference in definition. The only correct answer to the question, "Will a shark attack a man?" is "It depends upon the shark."

In justification of this very cautious statement, it should be explained that few animal families present so many and so diverse types as do the sharks. The dogfish, at most three feet long, is a shark; so is Carcharodon carcharias, the white shark, attaining a length of forty feet. In popular usage, however, the term "shark" may be taken to refer to some member of Carcharinus or a very similar genus, seldom or never exceeding ten feet in length, or to the giant Carcharodon already mentioned, the sole living representative of his genus.

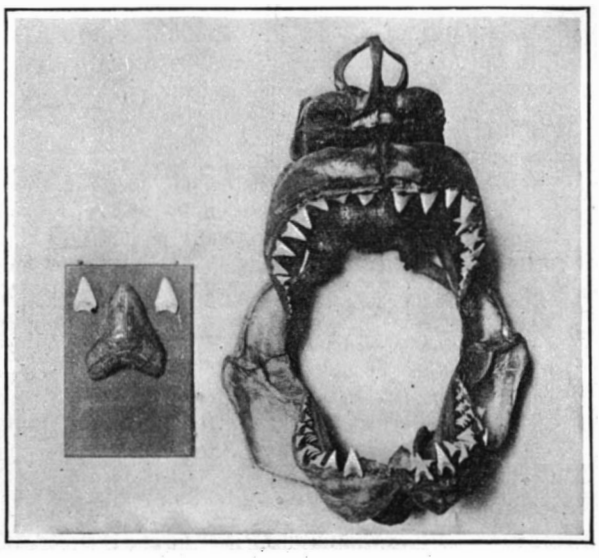
Even within these limits the shark presents such great variation that the bare question, "Will a shark attack a man?" must remain an academic one. The mouth and teeth go far to determine the degree of menace. The nurse shark, for example, is easily large enough to attack a man, but has too small a mouth to do so successfully. Other species have mouths large enough, but ill adapted, by reason of specialization to other ends, to preying upon human beings. Again, the shark, whatever his species, is more dangerous in tropical waters than in temperate; he is less of a menace near the coast than farther out, because only the smaller individuals frequent regularly the shallow waters; and he hunts much more freely at night than during the day, and is hence more to be feared at that time.

Concerning the great white shark there can be no controversy. His very designation, man-eating shark, betrays his formidable character. This is likewise evident from an inspection of his teeth. Many sharks have teeth sharpened for active service in the upper jaw only, those in the lower jaw amounting to little more than a bony surface for the others to play against. The white shark, however, as our cut shows, possesses a mouthful of very capable, sharply triangular teeth, well adapted for heavy cutting and tearing. With these he can, and does, attack humans freely.

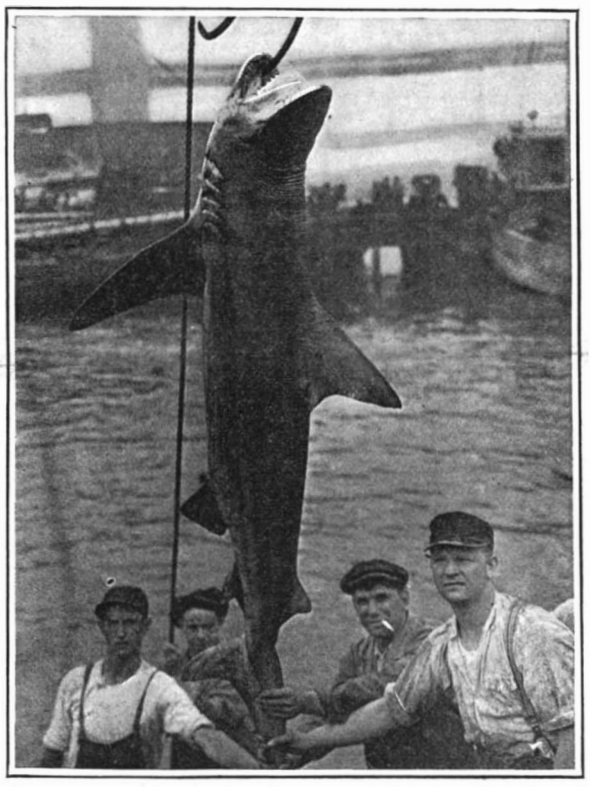
Dr. C. H. Townsend, of the New York Aquarium, has picked up from traders, pearl fishers, and other residents of the Australian Islands, many cases which he regards as authentically establishing this fact. He states that while the pearl-fishers and the natives who dive for money from the decks of the liners appear quite bold, they are so only up to a certain point. In their avoidance of localities with a bad reputation and in other little precautionary measures they are very circumspect; and it is only in the most desperate situation that a native of the shark regions of the Eastern hemisphere will venture into the water after the fall of darkness.

Fortunately, this giant of the seas is not normally to be found in the Atlantic. His home is in the tropical waters of the Indian Ocean and the Malay Islands, where he is to be found in great numbers. But occasionally he wanders far afield. He has been caught off the coast of Long Island; and our cut pictures a female taken near Provincetown some years ago. It is not, then, an *a priori* impossibility that one of these creatures is at large off the Jersey shore; and if this be the case, bathing will be unsafe until he is disposed of.

While not impossible, however, this is highly improbable. It is by no means necessary to postulate the existence of a white shark in Jersey waters to account for the attacks reported there upon humans. Various species of ground sharks and dusky sharks make their permanent homes in the warm water off the coast of Carolina and Florida, and among the West Indies. Migrating northward each summer for breeding purposes, they are found throughout the North Atlantic in July and August. They do not spawn, in the accepted sense of the term; the eggs are hatched within the body of the female, and the young brought forth alive.



Jaw of white shark, with comparison of tooth with that of fossil shark shown on cover



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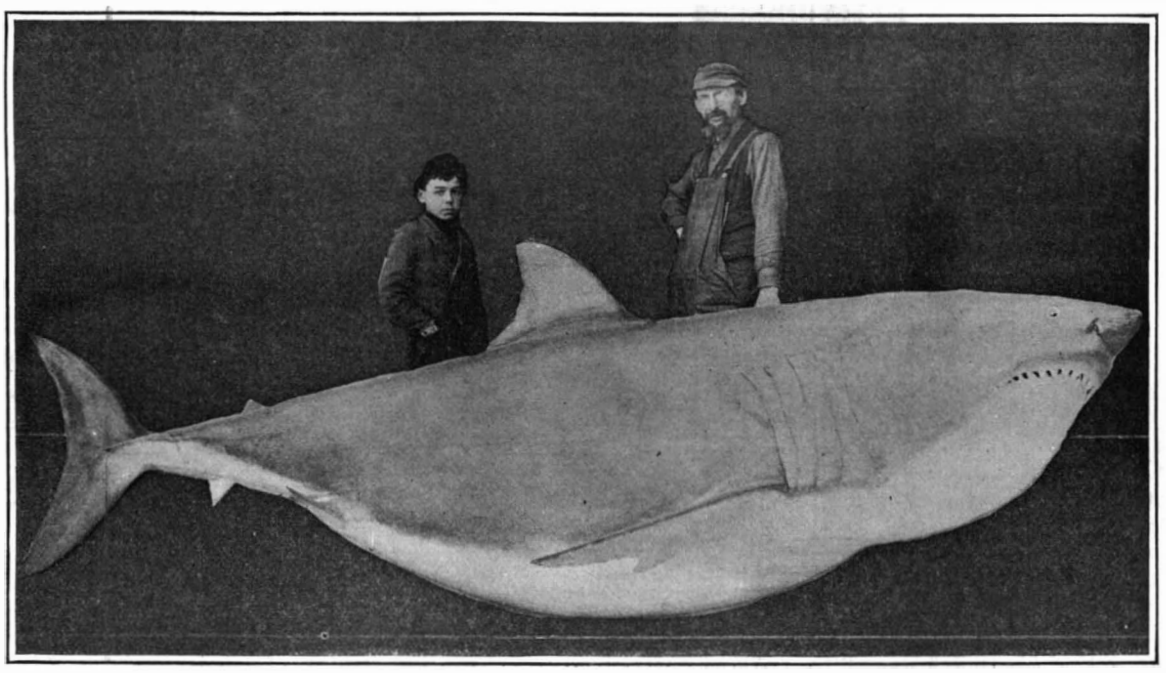
Large ground shark taken at Belfort, N. J.



White (man-eating) shark found in quantity in tropical waters

These sharks do not ordinarily range close along the coast, and they do not ordinarily attack humans; but competent authorities are certain that there are circumstances in which they might be expected to do both. A shark is extremely promiscuous in his diet. Like Mark Twain's white elephant, he will eat anything he can swallow; and he will manage to swallow pretty much anything he is likely to find. Sharks which followed the "Albatross" on her long voyage of scientific exploration eagerly bolted ham-bones, rotten oranges, dirty dish-cloths—anything, in fact, thrown overboard from the ship. But they are shy to the point of cowardice, and feed mostly at night. On this account a large part of their diet consists of dead animal matter. They are the hyenas of the sea. And, like the hyena, a shark when he is hungry will attack living animals; the hungrier he is, the less discriminating. A well-fed shark will not attack a man; but any shark physically capable of attacking a human with prospect of success might get hungry enough to do so.

As to why they should just now be sailing so close to the coast there is more occasion for speculation. Mr. J. T. Nichols, of the American Museum of Natural History, who has gone down to the scene of the reported attacks to investigate, reports as follows:

"The most plausible theory seems to me that the trouble is from one or several exotic sharks which are working up the coast; and we have determined to spend a day or two looking for them off Rockaway, in case they should cross to that side of the harbor, as is not unlikely if our surmise is correct."

It will be noted that he does not attempt to account for the presence off its beaten track of his hypothetical exotic shark; and perhaps this is no more necessary than it would be to account specifically for the presence of a man on the next street to the one he generally traverses.

It is still too early to state definitely what species of shark is responsible for the attacks upon bathers. Seeing a representative of a given species in the neighborhood is no kind of evidence. In fact, about the only final proof would be the catching of the guilty shark in the act of attacking a human. As instancing the force of this remark, a shark of one of the ordinary species was recently taken near the point where a boy bather had lost a foot. Upon finding in the creature's belly a fragment of a human bone, the local physician at once identified this as part of the shin-bone of a boy, and it was supposed that the guilty shark had been caught. A more competent authority, however, was able to point out that the fragment in question was from the right forearm of a very large and powerful man; and it is at least possible that the shark obtained it from a corpse. No amount of catching sharks, dead or alive, can establish conclusively the identity of the marauder, for the simple reason that it is known that there have always been more or less sharks within easy reach of the Jersey coast at this season. He will have to be caught in the act.

At the worst, we may console ourselves by contemplation of the perils which our antediluvian ancestors had to face in order to get an ocean bath. The American Museum of Natural History has in its possession a number of fossil shark teeth, found in a situation which indicates that they were all the property of one individual. On the basis of these teeth, the Museum has restored the jaw of this monster. The result is startling, as may be verified by a glance at our cover, which we owe to the courtesy of the Museum authorities.

It is a curious fact that the New York Aquarium has never been able to keep an adult shark. Such sharks are usually captured by accident, after getting entangled in the fishing nets. The director has had a number of them brought up to the city, but without exception they died within a couple of days. Inasmuch as he has been able to keep young sharks for several years, he suspects that the older ones injure themselves lashing about in the nets; and he has abandoned the effort to place a live adult shark on exhibition.

Inventions New and Interesting

Simple Patent Law; Patent Office News; Notes on Trademarks

A Novel Garage Convenience

THE accompanying cut shows a combination overhead washer and fire extinguisher for garage work, developed in Rochester, N. Y. Having two nozzles, it can be used to wash two vehicles at once, or to direct two streams of water upon a fire. Its effective range is about a hundred feet, so that one such installation would protect any ordinary garage completely. It is always ready for service, and is sufficiently light to be operated by a boy or woman with ease.

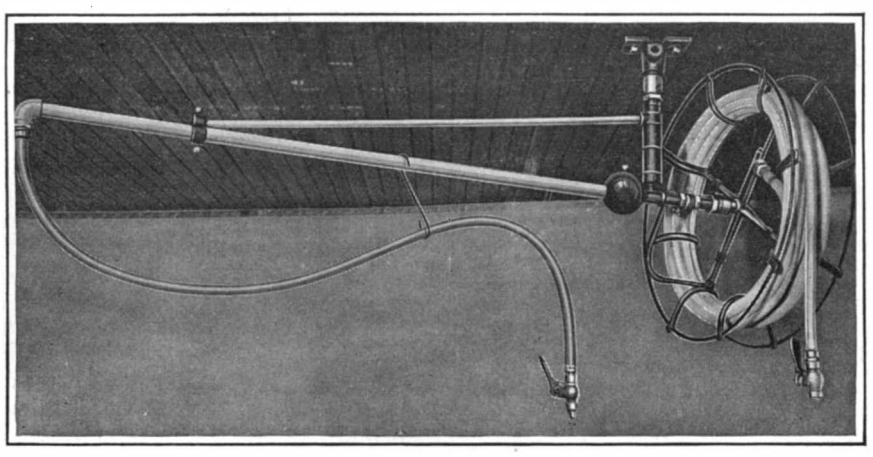
An Electric Meat Cutter

WE illustrate herewith an electric meat cutting machine of entirely new design, developed at St. Louis. It possesses greater rigidity than previous models, runs more smoothly, and is the nearest approach to perfect sanitation yet devised.

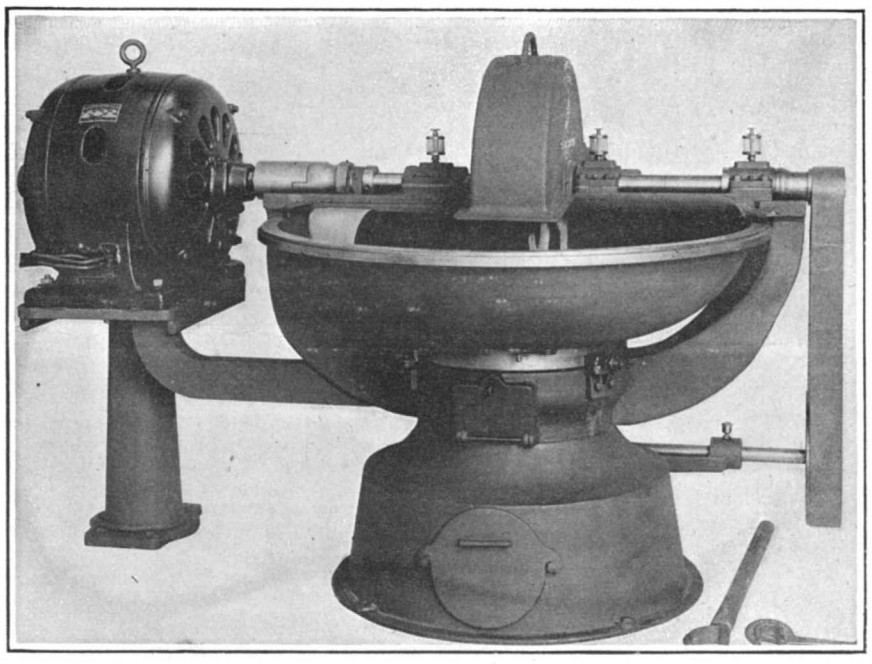
The vertical shaft which turns the bowl has a collar near the bottom with a ball race; this fits in a cup filled with oil in which the balls run, and which requires renewal of oil only once a month. This cup rests in a heavy crosspiece that carries the weight of the bowl in such a way that the minutest wear on the balls can be taken up with a set screw, which raises the oil cup and with it the bowl. The latter itself is held in place by four or more bronze side bearings that can be adjusted to fit and when once adjusted will hold it in place in correct relation to the traveling knives. These must follow a circle all the way inside the bowl in order to cut the sinews of the meat. The top outer edge of the bowl is flat, and hugs the under side of the table so closely that no meat can escape while being chopped. The edge is also lipped to prevent drip from running on the outside of the bowl.

An earnest effort has been made to render this machine fool-proof. The worm-shaft is never moved, and therefore, cannot carelessly be left out of place. The worm is covered to keep out foreign matter, but can be oiled by raising the cover. To start the machine all that is necessary is to give it a quick turn in the right direction, and this throws the motor over.

The machine is designed especially for cutting sausage meat, pickles, cabbage and fruit of all sorts. The smallest size made has a capacity of 50 pounds, with three knives of a maximum speed of 1,500 revolutions per minute.



Combination washer and fire-extinguisher, attached to garage ceiling



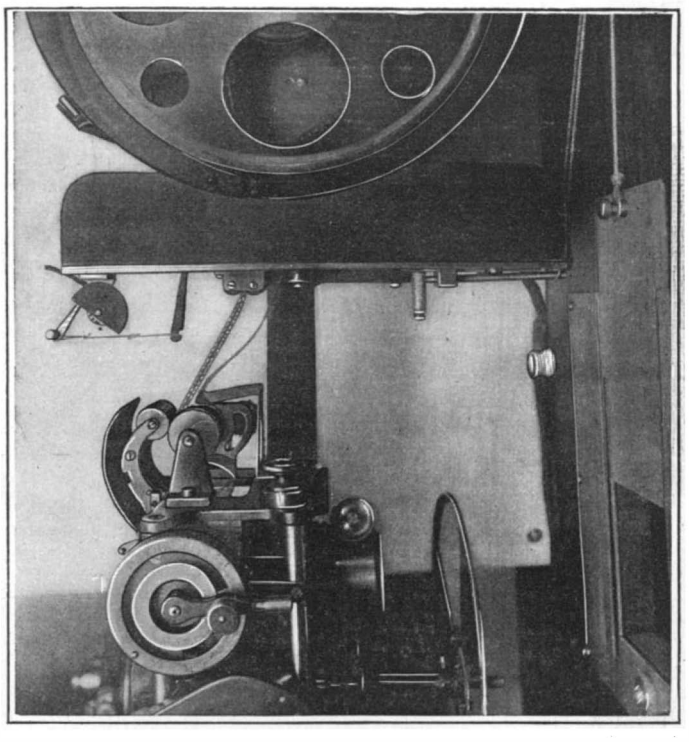
Electric meat cutter, with motor

Automatic Control System that Precludes Fire and Panic in Picture Theatres

A UNIQUE device that is destined to play an important part in the prevention of fires and panics in motion picture theatres, has recently been invented by a young mechanical engineer, Anton Szeliga, of New York. Experts, insurance men and others are agreed that as a safety device this invention is of prime importance.

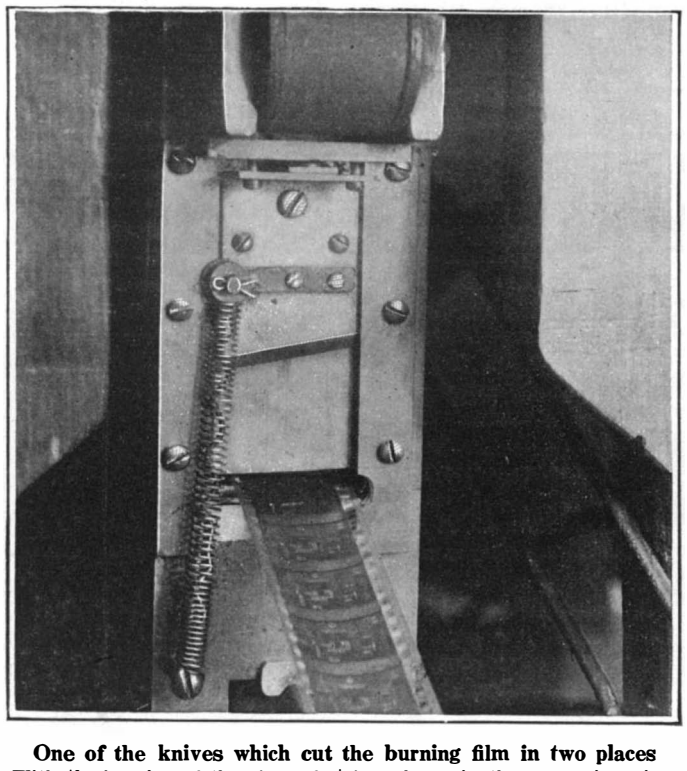
The new apparatus prevents films in projecting machines from catching fire or exploding, both of which, up to the present time, have been relatively frequent occurrences and have often resulted in injury and even death to persons, and extensive destruction of property. The device of Mr. Szeliga is a simple electrical contrivance that may be fitted at a slight cost to any make of projecting machine. Two sets of knives, housed at the openings of the film magazines, controlled by powerful springs and normally held in position by electro-magnets, are instantly released in case the film catches fire, cutting the film at the entrance to the magazines and absolutely sealing the latter. In this manner the fire is prevented from reaching the several hundred feet or more of film contained in the upper and lower magazines or retorts. Simultaneously, by means of an automatic control, the shutters in the fireproof booth front are dropped, the lights in the auditorium are turned on, a signal is flashed to the conductor of the orchestra to begin playing music designed to preclude any apprehension on the part of the audience, and the motor of the projecting machine is stopped. The same system of automatic control also extinguishes instantly the carbon arc in the machine. When the conflagration has burnt itself out, the net result is only about two feet of film and a few minutes of time lost in the exhibiting of the picture.

It is claimed that not a single person among the audience is aware of the fact that the film caught fire. The extinguishing of the flame is only a matter of a second or two. The turning on of the lights in the house and the sudden start of the orchestra detract all attention from the slight trouble at the projecting machine; hence, all danger of panic or catastrophe is avoided.



Mechanism for protecting a motion picture theatre against film fire

A piece of string, placed above the film mechanism, burns at the first flash of the film, releasing knives which cut the burning strip out of the balance of the film, and closing the apertures in the operating booth.



One of the knives which cut the burning film in two places

With the burning of the piece of string shown in the companion view, two guillotine-like knives are released, cutting the burning strip away from the balance of the film and protecting the latter.

English Manufacture of Crochet Needles

IN the manufacture of crochet needles in England the wire used is of the ordinary Sheffield make, cut into lengths for the different sizes required. A medium length would be about five inches. The wire is tapered on a machine from the center to one end, the other end being reserved for the handle. The shape of the end or hook is stamped with a hand press containing a die, which produces the hook in the rough. A press which works automatically is said to be now in use. The next process is called the "filing." This trims up the hook with a fine file by clearing away a burr of metal which has been spread out around the hook. This process requires a technical hand for the filing, as in its execution different sizes can be made. The cheap qualities of the crochet hook are made out of a tough wire, better qualities being made from high-class steel, and hardened. The hook is scoured bright and electroplated.

Soap as a By-Product of the British War Industries

THE relegation of soap to the category of by-products of soap factories is one of the anomalies wrought by the war in Europe. Glycerin is now the product of the chief value made at British soap works, although its manufacture is only incidental to the soap making processes. This reversal of the accepted order of things has been due, of course, to the demand for glycerin in the manufacture of munitions, of which it is an important constituent; and British soap makers are faced with the necessity of finding new or larger outlets for their wares, not so much, in the first instance, to sell more soap as to secure an increased yield of glycerin. The English public is being urged, as a patriotic demonstration, to decline to purchase imported soaps, since by so doing the overproduction of domestic soap is further increased.

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Efficiency of Farm Tractors

(*Concluded from page* 97)

to take the maximum pull of the heavy tractors would be quite cumbersome if several hundred feet long. The latter-mentioned method suggests the building of some sort of mechanism which would give the required steady load and at the same time not be too cumbersome or difficult to handle. One method of accomplishing this is shown in Fig. 4, where the tractor to be tested is shown pulling the apparatus with a dynamometer hitched between. The large rear wheel of this apparatus is made in the form of a drum, provided with solid heads so that the heads could be filled with water ballast. With suitable lugs or spurs on the face of the drum, and a heavy band brake at one end, sufficient load could be applied to hold practically any tractor in common use to-day. The small wheels at the front would carry the truck frame and take the reaction of the brake. One of these wheels would be connected to the dial drive of the dynamometer, thereby recording the distance traveled. With this type of instrument all of the factors necessary to calculate the draw bar pull, speed and horse-power would be attained.

Practical Tests Already Made

A recording dynamometer of the type referred to above is shown in one of the photographs. As will be noted it consists of a hydrostatic pressure unit (a) which is hitched between the tractor and the plows or loads to be hauled. This unit is connected by a flexible copper tube to a recording pressure gauge (b). The dial of this gauge is rotated by means of a trailer wheel (c) running on the ground and connected to the dial chart by a flexible drive shaft, as used on automobile speedometers. To obtain the running time a clock is provided with pen arm (d), which checks minute intervals on the margin of the chart. One of the records made by this dynamometer is reproduced herewith, this being the result of a test made recently in California, and illustrated in the head-piece. Much interesting information is being collected from these practical tests showing the difference in power required to pull plows and other farm tools in various parts of the country. This dynamometer will be used this summer at all the tractor demonstrations to test the condition of soil and determine draught necessary to pull plows in the different demonstration fields.

While these practical tests are of great value in determining plow draught, it is very difficult to test the maximum draw bar capacity of a tractor when using plows for the working load. This, because of the difficulty in quickly changing the adjustment of the plows to keep the pull constant.

Some sort of an apparatus for providing an even, steady, resistance to the tractor's pull, a means for measuring and recording this pull and means for recording the time and distance, or speed, are essential to determine successfully the maximum draw bar pull and power of a tractor. Some method of getting extremely uniform ground conditions for testing, so that each tractor will be on an equal footing, will be necessary if the resultant ratings to be established from such tests are to be comparable and just to all concerned.

It is hoped that at an early date the Government will authorize the proper department to build suitable testing apparatus for obtaining accurate data on tractor performance and to conduct a series of tests to establish a uniform standard rating for all farm tractors. Such a series of accurate tests would greatly assist tractor builders in developing better, more efficient tractors. Moreover, a standard rating would be of great benefit to the tractor-buying public, since it would assist the purchaser in comparing various tractors and in selecting one primarily suited to his individual need.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14122) R. R. M. asks: As a reader of your paper, would you please advise me regarding the following: The argument has been advanced that the "Titanic" is *not* resting on the bottom of the ocean, it being claimed that after going down a certain distance that the pressure of water would hold her in a position of suspension. By the same argument it has been advanced that a cannon ball of SOLID iron would at a certain depth stop its descent and be held in suspension on account of pressure. A. The "Titanic" is resting on the bottom of the ocean, probably crumpled into an indistinguishable mass by the awful velocity with which she struck the bottom. This discussion confuses pressure and weight. A body sinks in water or air when it weighs more than the same volume of water or air weighs. A man falls in the air, although the pressure of the air on the man is 15 pounds per square inch tons on his whole body. Air at the surface of the earth weighs 1¼ ounces per cubic foot, and the man falls because he weighs more than this. Sea water weighs about 64 pounds per cubic foot, and a ship or cannon ball which weighs more than this will sink in water. Since the water is nearly incompressible it weighs only about one-fifth more at the bottom of the ocean than it does at the surface, notwithstanding the enormous pressure there, and so a ship which sinks at all will continue to sink till it strikes the bottom, and with an increase of velocity all the way down. The ill-fated ship may have struck with a velocity of several hundred feet per second. The idea that a heavy body may be buoyed up by pressure is not sound. The question is simply one of relative weight or density.

(14123) J. B. D. asks: Is it true that if a peach twig with a Y shape is inverted and carried over the ground it will revert to the opposite position at all points where water may be found in quantities sufficient for a well? A. There has been much discussion from time to time about "divining rods." It is claimed that truly remarkable results have been obtained by their use. There is absolutely no scientific reason why any action, such as that claimed, should take place. The results, if any have been obtained, were undoubtedly due to purely psychological reasons. By that we mean that the operator of the "divining rod" was undoubtedly unconsciously influenced by surrounding conditions and the action attributed to the "divining rod" was entirely due to the mental reaction on the part of the operator. This is entirely possible because a superficial examination of any specified area will immediately tell the most likely location of subterranean water to anyone at all acquainted with waterbearing soils, etc. We recall one instance in which a man claimed to have located a leak in a water main by means of a "divining rod." Why should the rod indicate the location of the leak and not be affected by the water in the main until it was directly over the leak? Do you not suppose that the more moist condition of the soil, or the brighter green of the grass in the immediate locality had some effect on the wielder of the rod? That seems the more feasible solution to us.

(14124) P. B. asks: 1. I am building a Wimshurst Electric Machine. Would you advise me to use glass, or vulcanite for the plates? Which of the two gives the best results? Is vulcanite liable to warp? 2. Does the spark length increase with the speed in such a machine, or is the output increased? 3. Supposing a shell is fired from a gun at a high angle, would the shell land on its nose or in the same position as it left the gun? I saw several newspaper articles which claim it does not change position in its flight; is this correct? 4. Would a rifle bullet come down with the same force as it went up if shot up almost vertically? A. 1. You would better use glass for the plates of a Wimshurst machine. Vulcanite will not break, but it loses its value after a time by the separation of the sulphur with which the rubber was vulcanized. 2. The spark length increases with the speed. 3. The shell from a rifled gun comes down, as you express it, on its nose; in other words, it does not come down point up. It strikes a target with its nose or point. You would better get the SCI. AM., Vol. 107, Nos. 6 and 7, in which Admiral Twining has a very interesting article upon the flight of Projectiles. 4. A rifle ball does not come down with the same force as it left the gun. The air resists its upward flight so that it does not rise as far as its velocity would carry it without resistance. The air also resists its fall so that it does not acquire its full velocity of fall.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel

NAIL.—O. WHITE, Kellogg, Idaho. This invention provides for use in shoes and boots a nail in the form of a bar adapted to be countersunk or partly countersunk into the material of the outer sole and having at each end a calk extending beyond the outer face of the outer sole and having near each end of the opposite face a pointed spur or lug for piercing the sole of the shoe and for clenching on the inner face of the sole to bind the parts together.

SHANK FOR SEPARABLE LINK CUFF BUTTONS.—C. E. SKOOG, 7 Beverly St., Providence, R. I. This invention provides one-piece shanks having male and female engaging portions; provides a spring engaging member for the female portion, the resiliency of which is incorporated therein; and provides button shanks of the character mentioned adapted to be manufactured by automatic machinery.

SNAP BUTTON.—C. F. KLETT, Parkesburg, Pa. This invention relates to improvements in snap buttons, the object being to provide an improved construction of socket member having improved means for securing the same to the material to which the socket member is attached, which insures a rigid, immovable connection of the parts, and results in a strong

SNAP BUTTON.

and durable structure. A further object is the provision of a snap button in which a clamping washer is compressed to grip the material to which the socket member is attached. and rigidly hold the socket member in position in the material. The present invention is an improvement upon the construction illustrated in patent No. 1,118,022, granted to Mr. Klett on November 24th, 1914.

Electrical Devices

ELECTRIC DISPLAY DEVICE.—C. TREGONING, care of Hotel Wallace, 43d St. and Broadway, New York, N. Y. In this instance the invention has reference to display devices and particularly to an improved arrangement, whereby electric lights may be displayed as moving in many ways for producing the illusion that the lamps are being shaken.

Of Interest to Farmers

PORTABLE ROOF.—J. B. Y. WARNER, care of Dutcher Bros., 830 Powers Bldg., Rochester, N. Y. The invention is more particularly designed for providing a roof for stacks of hay, straw, or the like. It provides a structure that may be assembled in small compass in knocked down form for storage or shipping and which may be readily erected in any desired length, according to the size of the stack or other material or location to be covered or sheltered.

HAY RACK AND BOX FOR WAGONS.—G. E. W. PRIESS, 517 South 12th St., Saginaw, Mich. This invention relates more particularly to farm vehicles adapted to be readily arranged to provide a hay rack, or to provide a box or platform for carrying miscellaneous farm products in baskets, boxes, or other containers, or in bulk. It provides a construction in which a substitute will be provided in lieu of the ordinary cross bars, or poles.

DRAFT EVENER.—C. T. HANSEN, Big Sandy, Mont. The improvement provides an equalizer for attachment to a sulky or gang plow, and adapted to be attached to a tractor having but one bull wheel running in the furrow, the equalizer being adapted for use with a four-horse evener of the common type in such manner that one horse will be placed in the furrow and three on the unplowed ground.

PORTABLE IRRIGATION SYSTEM. — H. T. LIBBY, Alvin, Tex. The invention relates to irrigation systems which comprise a maximum proportion of movable parts, so that the system as a whole may be readily picked up and moved from one part of a field or orchard to another part thereof while at the same time the various movable parts may be shifted relatively to each other while the system is in use for the purpose of sprinkling water over a large territory and with a minimum of expense and trouble.

DUSTING MACHINE FOR FRUIT TREES.—J. H. WRIGHT, Middleport, N. Y. This apparatus is easily regulated for the purpose of insuring the discharge of the proper amount of dust material, whereby trees, vegetables and other crops may be uniformly dusted as the machine travels along the rows, thus enabling much larger acreage to be dusted by a single machine and a single operator in the course of a day than has been possible with other machines heretofore in use.

Of General Interest

LADDER BRACKET.—D. R. LUCAS, 912 W. North St., Kenton, Ohio. The inventor provides a bracket for use in connection with an ordinary ladder, for rigidly supporting a scaffold alongside a building, and wherein the arrangement is such that the scaffold may be connected with any part of the ladder, either the front or the rear, and at any point in the length of the ladder.

ADVERTISING DEVICE.—J. SENGER, 206 W. 30th St., New York, N. Y. The improvement provides a wheeled carriage in a frame attached to the advertising card displayed in public conveyances, which carriage is adapted to carry an advertising member and which will move relatively to the advertising card, due to the ascent or descent of the conveyance on the track, and also due to the sudden arrest or start of the conveyance on its track.

PNEUMATIC WELL FOR INK AND MUCILAGE.—B. BARLOW, Box 778 Chicago, Ill. In the present patent the improvement has reference to an ink well or mucilage well adapted to be employed in connection with ink bottles or mucilage bottles of standard makes and utilizing the said ink bottle or the mucilage bottle as a reservoir.

CIGARETTE CASE.—E. DOBROWSKY, 213 Summer Ave., Brooklyn, New York, N. Y. This invention has reference to cigarette cases of the magazine type; and the object thereof is the provision of a simple, compact, inexpensive and attractive cigarette case with which by a simple manipulation of the hand holding the case a lighted cigarette may be presented ready to be picked up by the lips.

COMBINED BRIDGE AND CATTLE GUARD.—W. W. BRIAN, Cuero, Tex. This invention is characterized by a series of fixed and a series of movable planks or equivalent elements, in which the fixed planks constitute supports for the movable ones, the latter being so arranged that they may be positioned in the same plane as and alternating with the fixed planks so that the bridge presents a continuous or unbroken road surface over which cattle may travel when this is desired.

LUBRICATOR.—W. CARPENTER, Liberty, Mo. This improvement relates to lubricators of the kind in which a lubricant is atomized, sprayed, or otherwise finely divided and mixed with steam or other elastic fluid and by aid thereof introduced into other machinery, such for instance, as the cylinders used upon locomotives and all other steam motors.

SHELL FUSE.—E. A. CLAUS, 156 67th St., Brooklyn, New York, N. Y. This invention has reference to combination fuses. An object thereof is to provide a simple, inexpensive and efficient fuse the detonation of which is accomplished either by the firing of a time fuse or by the impact of the shell or projectile with which the fuse is provided.

LEVEL AND PLUMB.—C. O. BOLTON, Grand Rapids, Mich. The improvement refers particularly to the class of spirit levels and plumbs. The primary object is to construct an instrument in which the level and plumb tubes or glasses are so arranged that either edge of the device may be used in order to secure a proper level and either end may be employed to ascertain the correct position of a given object.

IRRIGATOR.—H. N. HARPER, Ruston, La. The inventor provides a device capable of connection to a receptacle and arranged to be held in a central position with respect to the receptacle and in position to be engaged and to be held engaged without requiring attention from the user and leaving the hands of the user free.

Household Utilities

TIE FOR PIE AND SIMILAR PLATES.—H. E. SIMMONS, 310 Jefferson St., Rochester, Pa. The tie consists of gummed strips disposed transversely around a group of plates, the tie strips being affixed to the end plates and to a wrapper which is disposed around the plate edges. The edges of this wrapper are gathered at the edges of the end plates and are held in position by the strips, which are affixed thereto to provide rounded and cushioned corners which will prevent the edges of the plates from cutting the strips.

STRAP CLAMP.—A. ROBINSON, 3 Catharine St., New York, N. Y. The invention relates to means for holding straps in place upon a desired support, such as the straps supporting the springs in the upholstering of furniture, and provides means which will not injure the fabric of the straps nor permit said straps to have strain placed thereon other than across the entire width thereof, thus insuring full efficiency of the straps.

SPOON HOLDER.—F. BUTLER, Box 466, Oxnard, Cal. This invention relates to means for holding spoons, forks, and the like in a readily accessible position for use in bowls, pots, pans, etc., in such manner as to prevent their falling into the contents of the vessel, as when mixing or cooking in or serving from said vessel.

REVERSIBLE WINDOW.—J. L. KLEINMAN, 23 W. 112th St., New York, N. Y. The improvement refers to windows having sashes mounted to slide into a room to permit of conveniently cleaning both the inner and outer faces of the sashes. It provides a reversible window which is simple and durable in construction, and arranged to prevent leakage when the sashes are in normal closed position.

Machines and Mechanical Devices

RIBBED TUBE MILL LINER.—J. S. PETERSON and W. B. ROGERS, Smuggler, Colo. The invention refers to tube mills comprising a shell and a shell liner having longitudinal wear members or ribs on the interior. It provides liner sections, and each section has longitudinal ribs or wear members individually removable to renew the same, the said liner sections and their respective attachable ribs having a matting formation to effect the detachable connection of said ribs.

WRINGER.—G. H. ROSS, 1138 49th St., Brooklyn, N. Y., N. Y. The invention pertains to machines for expressing water, juices or moisture of various kinds from cloths, clothing, fruit or other commodities, and has particular reference to a device for providing for the thorough extraction of water or moisture from commodities by the application of a torsional force exerted through the rotation of a crank or its equivalent.

VALVE MECHANISM.—H. E. TEMPLE, care of West 42d St. Ferry, New York, N. Y. An object here is to provide a valve in a suitable casing operable by a piston having an auxiliary valve whose opening is gradually increased with the opening of the main valve to admit an increasing quantity of fluid above the piston and equalize the pressure in the chamber above the valve in any mid position, thus providing means for controlling the flow of liquid, air, gas, etc., from remote points, either automatically or manually through a suitable primary pilot.

MOVING SIGN.—H. CROSS, Bigtimber, Mont. The invention relates to moving signs adaptable for both day and night formed of an endless belt having letter plates detachably connected therewith, whereby said plates may be easily and quickly removed to display different legends or other subject matter by the substitution or rearrangement of other plates or those previously employed.

MACHINE FOR GROOVING WEATHER-BOARDING.—W. E. AYCOCK, care of Aycock Wood-Brick Veneer Co., Aycock, Fla. The machine forms transverse grooves in elongated strips of weather-boarding in such manner that the depths and relative spacing of the grooves may be accurately controlled. The machine is one in which the parts are so disposed and related that ready access may be had to the saws or cutters for purposes of adjustment, substitution and repair.

GATE.—P. E. SHIPP, care of Bourbon Remedy Co., Lexington, Ky. The inventor provides a gate arranged to swing in either direction from closed to open positon, and having mechanism in connection with the gate adapted to be operated at a distance from the gate for opening and closing the gate, the said mechanism being arranged at opposite sides of the gate, and arranged to open or close the gate in accordance with its position at the time said mechanism is operated.

KEYBOAD FOR TYPE WRITING MACHINES.—C. K. SEARLE, care of Remington Typewriter Co., 327 Broadway, New York, N. Y. This invention provides a keyboard arranged to provide a set of auxiliary keys without changing the arrangement, location or size of the keys of the original standard keyboard, at the same time enabling the operator to readily reach the extra keys without danger of striking the wrong key, and thus insure more accuracy and speed of the operator both as to the use of the original keys and the set of auxiliary keys.

CIRCULAR SORTING OR CONVEYING TABLE.—E. HENDERSON, Demmon, Mich. The table is mounted to be revolved and ore is fed thereto so as to be carried as the table revolves past workmen stationed about the table to pick out the barren rock. A plow is disposed above the table in the path of movement of the material being sorted and upon reaching the plow is swept from the table. The plow is sustained in position in a manner to be displaced where desired and whereby the inertia of the plow is effectively utilized in preventing accidental displacement of the plow.

Prime Movers and Their Accessories

CARBURETER.—R. J. ROBERTSON, 473 Park Place, Brooklyn, N. Y., N. Y. An object here is to provide a carbureter which presents a double supply of fuel in a finely divided condition when the carburetor is being used for high speed and a single supply when the carbureter is used for low speed, whereby the richness of the mixture is maintained substantially even throughout.

INTERNAL COMBUSTION ENGINE.—B. F. SPARKS, 516 18th St., Huntington, W. Va. This improvement has reference to valves of the rotary sleeve type. It provides an internal combustion engine having a rotary sleeve valve which is to be fitted into the bore of the explosive motor and the valve in its turn acts as the cylinder or bore in which the working piston operates.

CARBURETER.—O. KUSTEL, West G St., Ontario, Cal. In this mechanism a valve casing is provided, having a valve for controlling the inlet of air and having a feed screw for controlling the inlet of the fuel, and wherein the feed screw and the air inlet valve are connected in such manner that they will move together, and wherein either may be adjusted with respect to the moving means independently of the others.

BOILER WATER JACKET.—G. ALTIMARE and J. LOVELL. Address the former 2308 Corning Ave., Parsons, Kan. In this instance the invention relates to steam boilers and its object is the provision of a new and improved water jacket for such boilers to prevent cold drafts from reaching the flues and flue sheet with a view to prevent leakage due to sediment, expansion, and contraction.

SAFETY STARTING DEVICE.—W. SCHEURER and R. SCHEURER, Weehawken P. O., 210 16th St., West New York, N. J. In the present patent the invention has reference to safety devices for the manual starting means of internal combustion engines, and the main object thereof is to provide means for preventing injury from premature explosion or back fire to a person while starting the engine.

CARBURETER.—H. W. ALLEN, P. O. Box R, Coalinga, Cal. The invention provides a device wherein the carbureter is provided with valves for controlling the inlet of air and fuel, together with the mechanism for permitting the said valves to be simultaneously controlled, and so arranged that they may be adjusted with respect to each other independently, and wherein the carbureter is provided with other mechanism for thoroughly and intimately mixing the charge to provide a uniform homogeneous mixture.

Pertaining to Vehicles

DUMP CART.—C. WOLLERSEN, 514 W. 46th St., New York, N. Y. The inventor provides a cart which is more easily loaded than those now known to him, which is quickly and easily unloaded in a practically automatic manner, which provides a substantially telescopic connection between the wagon frame and the load carrying body practically immune from the entrance of extraneous matter, and which is especially adapted for dumping from a dock to a scow the deck of which is at a lower level than the dock.

VEHICLE FOR TRANSPORTING AEROPLANES.—J. SLOAN, 17 Rue du Louvre, Paris, France. Vehicles hitherto proposed for transporting aeroplanes generally consist of a chassis or carriage frame surmounted by a framework consisting of a number of half hoops connected by longitudinal beams and planks, the whole being covered with an awning or any other means of covering. The aeroplane body, detached from the wings, occupies the middle, and the wings are arranged on either side inside the vehicle. The present invention provides a vehicle which has none of these drawbacks and which may be made very light.

SPRING WHEEL.—J. EHRHARD, Curtis, Okla. This invention has in view the production of a wheel in which the rim will be supported by resilient units so constructed and arranged as to result in a shock or yielding at one portion of the wheel being distributed to the several units throughout the wheel.

TIRE.—F. D. BROWN and R. S. BROWN, R. 4, Box 27A., Josephine Co., near Grants Pass. Oregon. The invention pertains particularly to a tire which will act as a substitute for pneumatic tires, and also as a substitute for rubber in solid tires, and has for an object the provision of a simple and strong structure which presents resilient means without danger of puncturing or skidding.

VEHICLE SPRING SHACKLE.—J. J. CRAWFORD, 1255 Castleton Ave., W. New Brighton, S. I., New York, N. Y. The invention provides a relatively sensitive resilient connection for the ends of leaf springs for absorbing the minor vibrations and for preventing the snapping of the top leaf incident to the lift of a vehicle body; provides a shackle formed as a single unit, and easily applied; and provides a shackle shaped to replace the conventional link shackle, thereby avoiding the necessity for special parts or alterations in the construction of conventional parts.

Designs

DESIGN FOR AN ELECTRICAL TRANSFORMER CABINET.—BERTHA FLUSH, 250 W. 94th St., New York, N. Y. In this ornamental design for an electrical transformer cabinet, the article is in form a square upright structure with a flat top with beveled edges. The body is plain but of striking appearance and elevated on four feet.

DESIGN FOR A DOLL OR STATUETTE.—R. S. ILSLEY, 10143 101st St., Edmonton, Alberta, Canada. This design shows a representation of a man past middle age, having a head nearly bald with a little tuft of hair over his forehead and bushy hair at his neck, the man having a monocle at one eye.

DESIGN FOR AN EMBLEM.—CORNELIA MACK. D. PECK, Ballwood Road, Sound Beach, Conn. This design consists of a male and a female figure in the conventional garb of the United States to symbolize Aunt Sam introduced by Uncle Sam.

DESIGN FOR A SHOWER PLATE FOR GAS AND ELECTRIC FIXTURES. — B. SCHWARTZMAN, 15 Laight St., New York, N. Y. This design in both plan and edge views shows a projecting center and flat surface ornaments of beautiful, elaborate and graceful outline.

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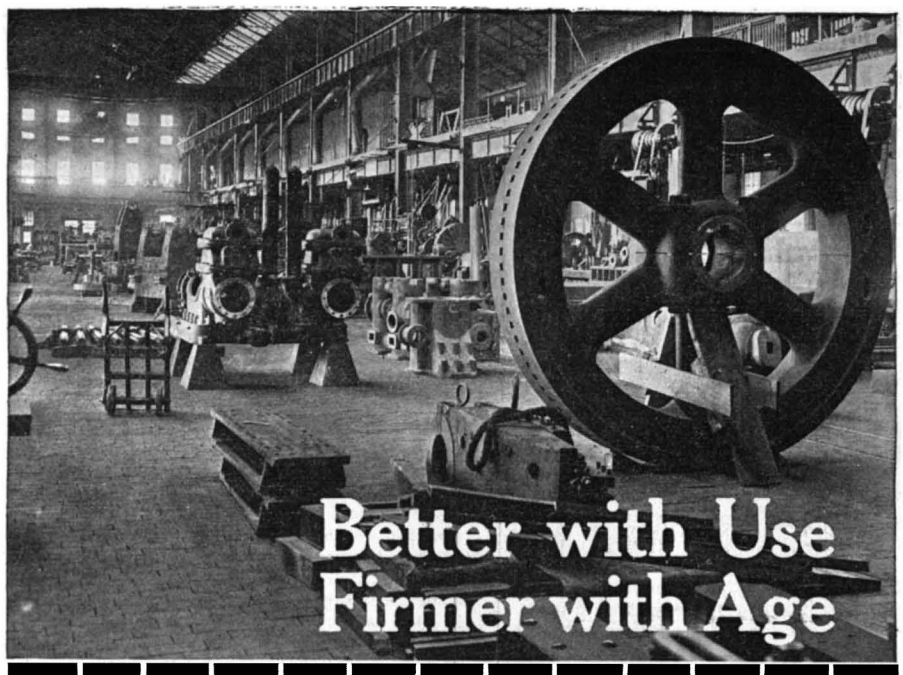

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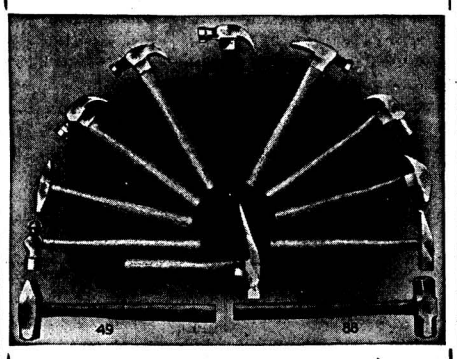

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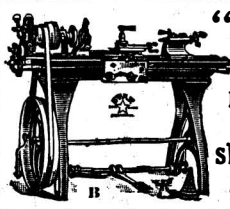

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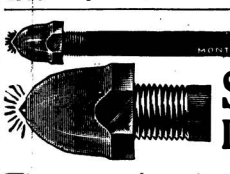

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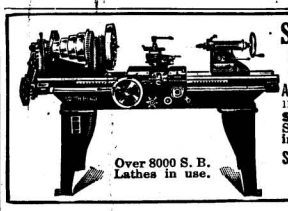

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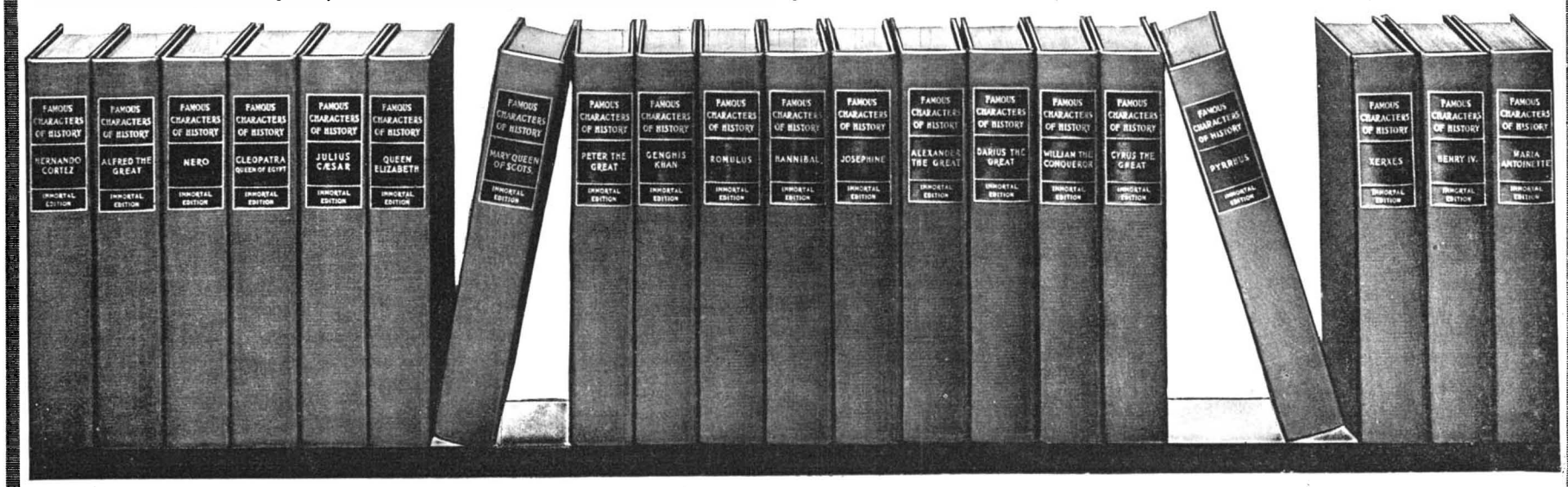

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